AUDIO ENGINEERING

DECEMBER
1950
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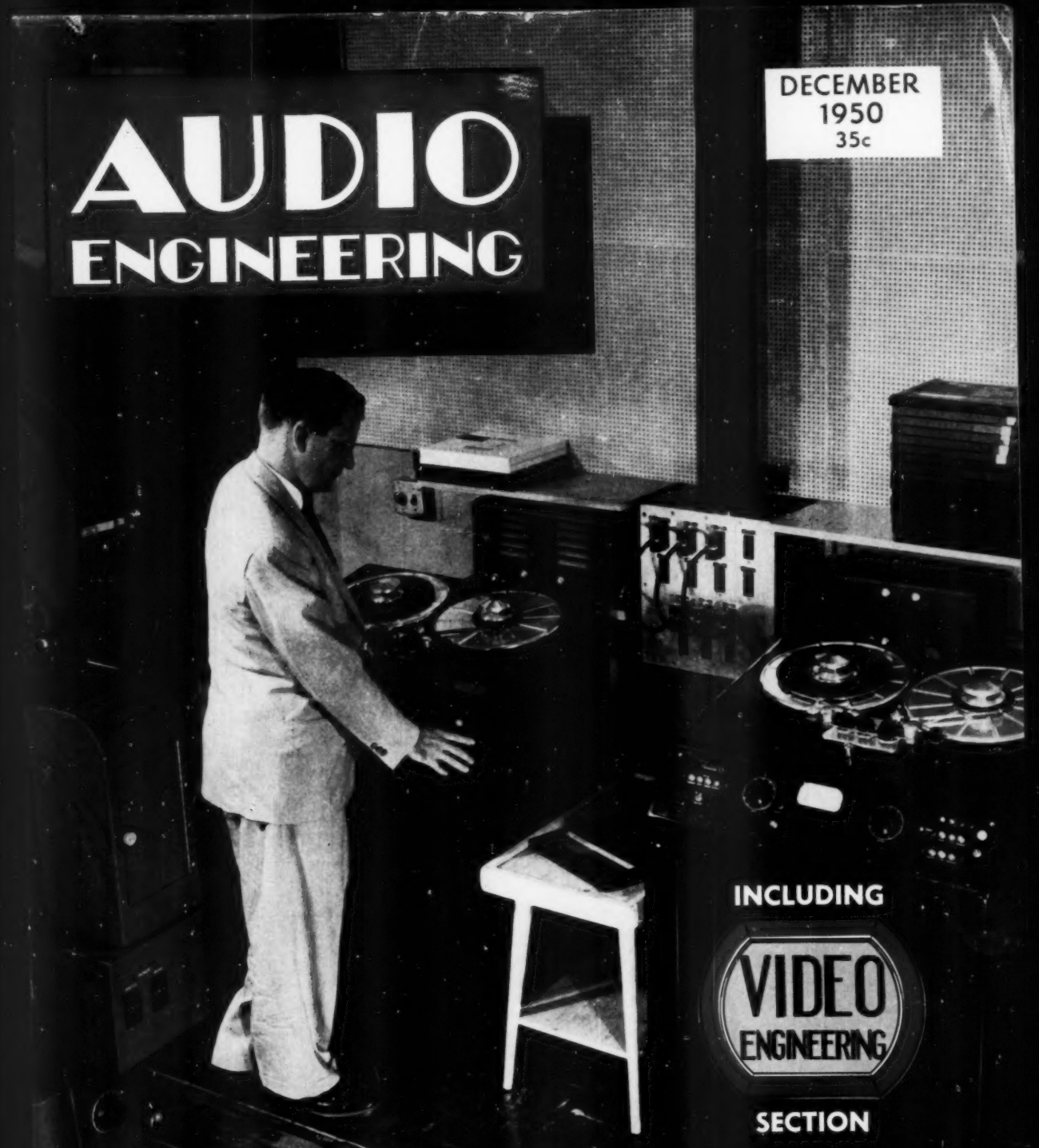

INCLUDING

VIDEO ENGINEERING

SECTION

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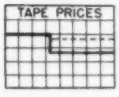

—enabling radio stations, recording studios and educational institutions to save as much as 33⅓% on the cost of magnetic tape.

First **with attractive resale discounts**

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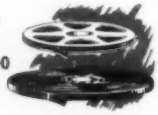

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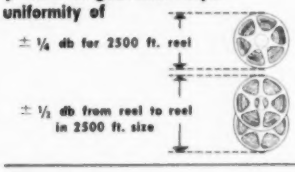

First **to produce a splice-free 2500 ft. roll**

—to *guarantee* that the tape is all one piece, with absolutely no splices in the entire length.

First **to develop the safe-handling package for professional-size rolls**

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COVER

Mr. Price Fish of CBS General Engineering Dept. is seen with two of the Fairchild PIC-SYNC Magnetic Tape Recorders installed at the WCBS-TV Studios (New York). This ¼-in. tape equipment is the heart of the CBS-TV "Mag-Neg-Tic" TV recording technique of reproducing sound from the tape in synchronism with motion picture film. A Fairchild PIC-SYNC installation at the Hollywood CBS Studios includes recording and production editing facilities for the preparation of magnetic tape sound and TV picture film recordings for release from New York on the video network.

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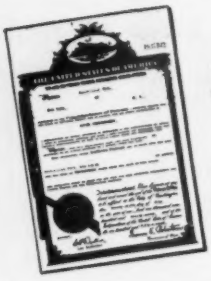

AUDIO PATENTS

RICHARD H. DORF*

CONDENSER MICROPHONES (or should we say "capacitor microphones" these days?) are among the best available when they are designed correctly. They were used for a long time in broadcasting and are now reappearing in improved versions. One of the headaches connected with their use, however, is that a "head" amplifier must almost always be placed within a few inches of the microphone because the small microphone capacitance would be swamped by the capacitance of leads of any length.

One solution, of course, is the use of a cathode-follower at the end of a cable, since ordinary cathode followers can decrease the effective input capacitance by as much as 100 times. Even this is not sufficient, however, for with the conventional pentode cathode follower using a 0.5-meg. grid resistor—without any cable to speak of between microphone and grid—and a 25-μμf microphone the lower cutoff frequency (3 db down) is about 150 cps. Higher grid resistor values make for unstable operation.

The "supercharged" cathode follower illustrated in *Fig.* 1, however, lowers the cut-

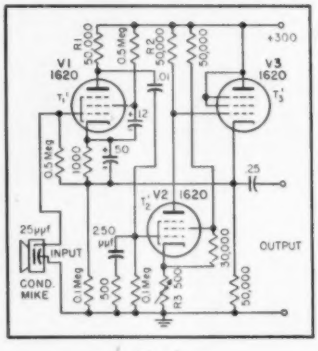

Fig. 1

off to 20 cps and even allows a 1,000-μμf length of connecting cable to appear between microphone and grid with negligible effects. It is the invention of Paul S. Veneklasen and is assigned to the United States as represented by the OSRD. The patent number is 2,508,586.

The first 1620 in *Fig.* 1, V_1, is a conventional cathode follower except that there is also a plate load resistor R_1. The plate output of V_1 is fed in the conventional way to the grid of V_2, whose plate load resistor is R_2. The grid of V_3 is directly coupled to the plate of V_2; V_3 is a second cathode follower. The output—that is, the cathode—of V_3 is connected across the output of the cathode follower V_1. Since it is in phase with the V_1 cathode output voltage the total feedback of the circuit is greatly increased.

For the circuit shown the effective input impedance (at the grid of V_1) is

$$R_i = \frac{1}{1-G}$$

where G is the incremental gain from input to output. If R_i is to be large, as is desired, G must be very high, close to unity. And if the gain of V_2 is infinite then

$$G = \frac{\mu}{\mu - 1}.$$

The insertion of V_3 makes for very large incremental gain, which makes the net feedback also very great. The effective input impedance thus is very much higher than for a conventional cathode follower and the effective input capacitance is correspondingly reduced.

The inventer's experiments and calculations show that with the 25-μμf microphone working into a conventional pentode amplifier with a grid resistor of 0.5 meg., the lower-frequency cutoff is 13,000 cps. With an ordinary pentode cathode follower and the same grid resistor, cutoff is at 150 cps. With the supercharged circuit the response is flat to 20 cps. Addition of a shunt grid capacitor of 1,000 μμf, such as might be present due to a length of connecting cable between microphone and grid, resulted only in a loss of 1 db below 10,000 cps.

The supercharged circuit, therefore, is increased by a factor of about 300. Points A and B must be at the same d.c. potential. That at A is adjusted by breaking the connection between the points and setting R_3.

Heterodyne Oscillator

One of the common troubles in beat-frequency test oscillators is "pulling" between the oscillators when they approach the same frequency. The result is that the beat value is usable only down to a certain minimum frequency, below which the oscillators suddenly lock. The usual solution is separation of the oscillators, thorough shielding, and sometimes by adding buffer isolation between each oscillator and the mixer.

Ivor R. Worsley of London, England, has designed a beat-frequency oscillator for which the necessary space and cost have been reduced and which has a special arrangement to reduce the effects of pulling between oscillators. The patent, No. 2,510,165, is assigned to International Standard Electric Corp. The circuit is shown in *Fig.* 2.

The factor making for the reduction of space and cost is the use of a triode-pentode tube, such as the 6F7 (the inventor did not mention this tube). The triode section of the tube is used for the fixed oscillator and

[*Continued on page 47*]

* *Audio Consultant, 255 West 84th Street, New York.*

LETTERS

Ground Loudspeakers

Sir:

It was with great interest that we found in AUDIO ENGINEERING, October 1949, an article on Ground Loudspeakers.

We avail ourselves of this occasion to draw your attention to the fact that ground loudspeakers have been developed and installed in the Olympia Stadium in Berlin by Telefunken as early as 1936. A description of the ground loudspeakers, the performance of which was fully satisfactory, is to be found, for instance in the periodical *Telefunken-Hausmitteilungen* No. 79 (1938) pages 66 and 67.

TELEFUNKEN
Gesellschaft für drahtlose Telegraphie m.b.H.
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Choral Recording

Sir:

For a long time there has been a controversy between engineering balance and the proper acoustical balance of orchestral and choral groups. Unfortunately this controversy stems from the failure of engineers and conductors getting together on interpretation of individual selections.

We are currently specializing in large *a capella* and choral groups including the famous St. Olaf Choir of Northfield, Minn., the Concordia Choir of Moorhead, Minn., The Notre Dame Cathedral Choir of Paris (France) recorded in the cathedral itself, The Cathedral Choir of the First Presbyterian Church of Hollywood, and many others. These choirs consist of about sixty voices, and we have found in many instances that it is necessary to rearrange the music for proper recording balance. There is a vast difference between a concert arrangement and a recording arrangement, which few engineers or musical directors recognize. As a result there is always the tendency to run into shattering or complete loss of balance on high-volume passages.

It is practically impossible to record consecutive thirds in women's voices and maintain proper diction or definition. However, if a simple expedient of inversion is applied to the music itself the results are very gratifying. The foregoing, of course, is just one of the many problems to be met on individual selections, and impossible to get across to some musical directors for it is treading on sacred ground, so to speak. Any good director can usually be interested in the laws of acoustics in recording if properly approached. Here the engineer should be thoroughly versed in musical terminology in order to get his point across. A good approach is to point out that film, radio, and phonograph recording has a distinct technique of its own to be met and if the director is given an opportunity to see what happens when these problems are not met, he will correct the situation.

On the surface, this report may sound ambiguous, but the writer has spent years in research and study from the viewpoints of musicianship, scoring, and engineering, and has given many courses in colleges throughout the country in acoustic balance. It is a highly specialized field of research, and is extremely fascinating. To both the engineer and the musical director it opens horizons in music that have not been touched.

Eddison von Ottenfeld, Mus.D.
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RCA TAPE RECORDER *Type RT-11A*

50 to 15,000 c.p.s. (±2 db) at 15 in/sec
50 to 7,500 c.p.s. (±2 db) at 7½ in/sec

COMPLETE—with motor board, plug-in type recording amplifier, plug-in playback amplifier, two standard NAB reels, power supply and panel and shelf.

- **Split-second start and stop**
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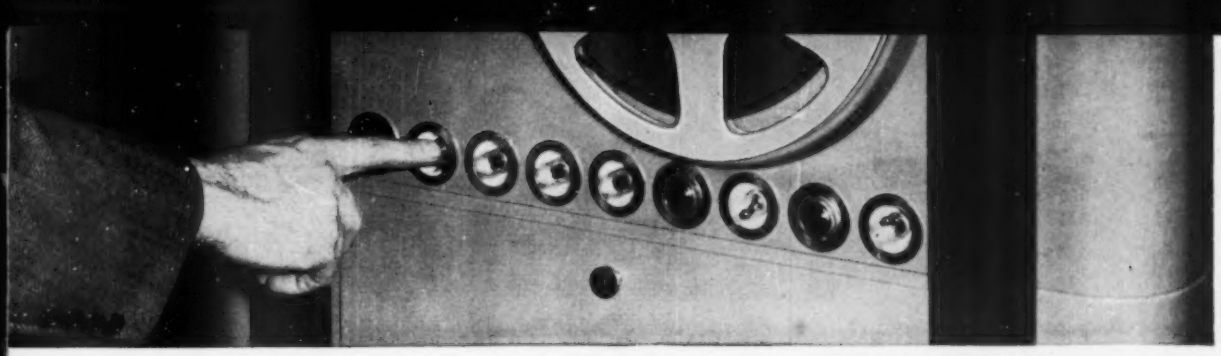

PUSH-BUTTON CONTROL puts tape recording facilities at your fingertips.

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High-Fidelity Tape Recorder

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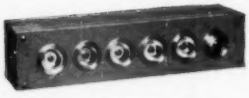

Remote Control Unit, MI-11948. Available extra.

This is the world's foremost professional tape recorder, the one recorder that has *everything*—accurate timing, low wow and flutter, plus quick starting. All operations are push-button controlled. All functions—including cueing—can be extended to remote positions.

Designed for applications where operating TIME and RELIABILITY are prime factors, the new Type RT-11A Recorder offers a number of exclusive features. For example, you can start or stop the tape in 0.1 second. You can jockey the tape back and forth for cueing without stopping. You can rewind a standard 10½-inch reel in one minute!

A synchronous capstan makes it practical to hold recording time to ±2½ seconds in a 30-minute run. And with synchronizing equipment . . . for which provision is made . . . *timing can be held to 0.3 second on any length program!*

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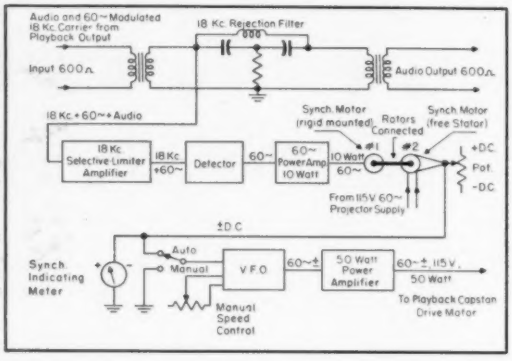
TECHNICANA

Tape-Movie Synch

The accurate synchronization of ¼-inch magnetic tape recordings with motion picture films is covered by Walter T. Selsted in *J. Soc. Mot. Pict. Tel. Eng.* for September 1950. The equipment was designed to work with the Ampex model 300 and consists of a synchronizing signal generator and differential speed detector and power amplifier. The synchronizing signal is an 18-kc tone modulated by the sixty cycle voltage supply for the motion picture camera. The audio input and the modulated 18 kc are then recorded on the tape.

In the playback the 18 kc is filtered from the audio output and fed to an 18-kc limiter amplifier, 60-cps detector, and 60-cps 10-watt power amplifier. This approximately 60-cps signal drives a rigidly mounted synchronous motor, the rotor of which drives the rotor of a second synchronous motor with a free stator. The second stator is fed from the 60-cps supply driving the projector. If there is a difference between the output from the tape and the projector supply, the second stator will rotate. The second stator operates a d.c. potentiometer controlling a variable-frequency oscillator. The oscillator output is near 60 cps and is corrected by the two-motor differential system to synchronize the tape. The tape drive capstan is driven from the oscillator through a 50-watt amplifier.



Phono-Tape Adapter

The Italian journal *Radio* for September 1950 carries the description of an assembly to adapt a phonograph-radio into a tape recorder.

Using no motors, the unit derives its power from the phonograph drive spindle through a variable speed system. The tape speed is about 15 in./sec., and the tape is driven in both directions to provide a total recording time of 15 minutes. The radio-phonograph amplifier is used for both record and playback, while the assembly contains the bias oscillator. The general claim for the adapter is its low cost, which is made possible by the elimfnation of any motors. The quality is said to be adequate for music.

Motion Picture Tape

Loren L. Ryder reporting in the *International Projectionist*, September 1950, states that large savings in the production costs of motion pictures are being effected through the use of magnetic recording film systems. Production, scoring, and dubbing recordings are largely magnetic-to-magnetic with only the negative for release printing having a photographic sound track.

In practice, two recorders, each loaded with 2500 feet of film, are assigned to each production, eliminating loading delays and minimizing run-outs. The recorders are fully automatic, being turned over and "killed" by the cameraman as he operates the camera. Synchronization is also automatic. When trouble appears the equipment is exchanged.

Such use of magnetic film has eliminated much of the film costs formerly required in dubbing and editing, since the magnetic film is never cut and may be used indefinitely.

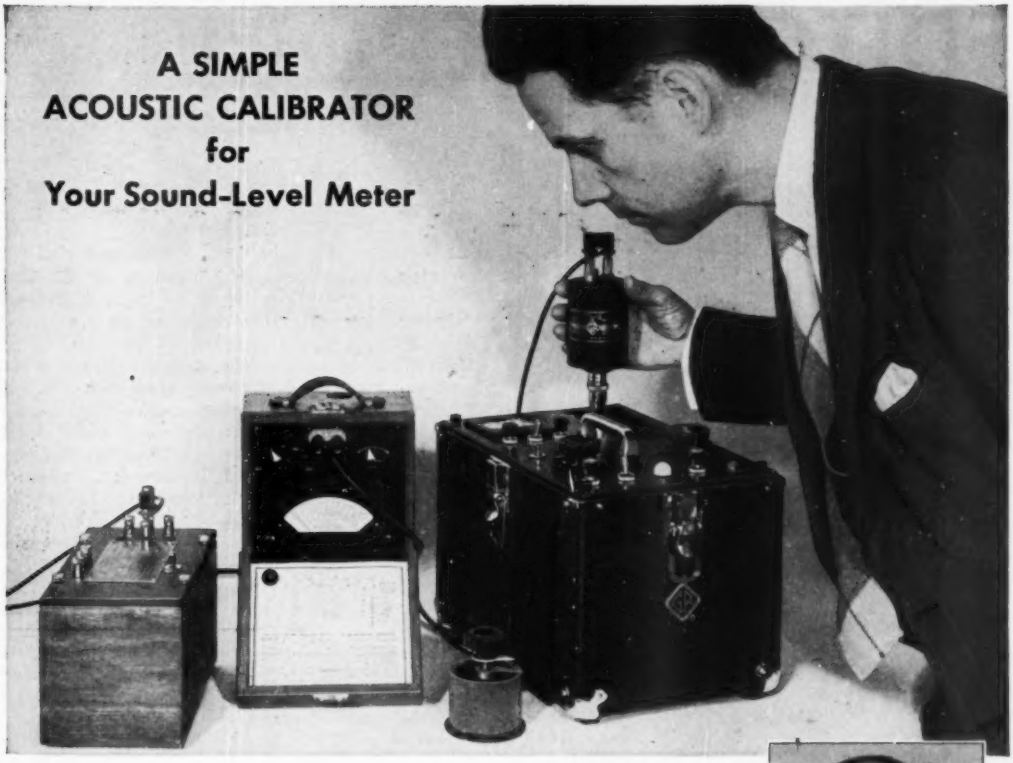
Australia Audio

The importance of high quality audio equipment in radio broadcasting is the subject of an article by J. E. Telfer in the *Amalgamated Wireless Technical Review* (Australia) Vol. 8 No. 4, June 1950. In this 30-page paper Mr. Telfer discusses the fundamental requirements of studio design and broadcast audio facilities. Various pieces of equipment are described and illustrated. Many of these are of Australian design and others are American.

One important phase of the discussion is the comparison of the land line facilities in the United States and in Australia. In the U. S. the four major networks employ 130,000 miles of telephone circuit, while in Australia only 8,000 miles of land line are used. However, the Australian lines cover

[*Continued on page 48*]

A SIMPLE ACOUSTIC CALIBRATOR for Your Sound-Level Meter



THE G-R Type 759-A and -B Sound-Level Meters have built-in calibrators for their electrical circuits; no means are readily available, however, to check the condition and calibration of their associated microphones.

The new Type 1552-A Sound-Level Calibrator is introduced as a simple, convenient and accurate method for calibrating both the microphone and the over-all system. Essentially it consists of a small, stabilized and rugged loud-speaker mounted in an enclosure which fits over the microphone in the sound-level meter. The acoustic coupling between the calibrator and the microphone is fixed and can be repeated accurately. Any audio oscillator with a harmonic content of less than 5%, supplying 2 volts at 400 cycles, can be used to operate the calibrator. A 500-ohm potentiometer is required as an output control if the oscillator is not equipped with such a control. An accurate vacuum-tube voltmeter is needed to measure the voltage across the calibrator.

The level at which the calibrator is used is such that its operation is not affected by ordinary background noises. This simple device is an ideal means not only for assuring consistency of calibration and locating defective microphones, but also for inter-standardization of several sound level meters.

The audio oscillator, v-t voltmeter and potentiometer shown in the set-up photograph are standard G-R items. If you need these or if you do not know about the complete line of G-R noise and vibration measuring and analyzing equipment. **WRITE FOR THE "NOISE PRIMER".**

The Sound-Level Calibrator was designed for use primarily with the Shure Brothers Type 9898 microphone as used on the G-R Type 759-B Sound-Level Meter. It can be used on other microphones such as the Brush BR25 Sound Cell Microphone and the Western Electric Type 633-A Dynamic Microphone.

TYPE 1552-A Sound-Level Calibrator $45.00

GENERAL RADIO COMPANY Cambridge 39, Massachusetts

90 West St., New York 6 920 S. Michigan Ave., Chicago 5 1000 N. Seward St., Los Angeles 38

EDITOR'S REPORT

MONITORING SYSTEMS

THE IMPORTANCE of monitoring systems is often overlooked by the design engineer or by the purchasing department when a recording studio installation is being laid out. It is not enough that just any loudspeaker system be located somewhere in the monitoring booth, with the hope that it is capable of reproducing the material so that it is possible to determine accurately the balance of an orchestra or between the orchestra and a singer, for example. Monitoring systems—from the point where the amplifier is tied to the recording system clear to the acoustic output of the speaker into the air—are of tremendous importance, and influence the quality of the entire product.

As an example, assume that a monitoring system is deficient in bass. In order to obtain well balanced reproduction, the musical director may insist upon additional equalization of the low frequencies or a change in microphone placement, with the result that the product has too much bass if reproduced on a standard system. This will not show up on playback because the same system is used both times, and the increased bass level on the recording will appear to be correct when reproduced on a bass-deficient system.

Obviously, the same condition can obtain with high frequencies, but an even worse loss may be caused by the presence of an untoward number of people in the monitor room during the recording. If a microphone setup is made with only the musical director and the engineer in the monitoring room and the balance is apparently correct, it should be apparent to anyone that the influx of a number of people who presume to have an interest in the recording will most certainly affect the acoustics of the room. Changes in balance to compensate for changes in monitoring conditions will be reflected in the recorded result.

For a variety of reasons, radio stations provide a clients' booth in many cases, and it is usual for the number of persons in the monitoring room to be restricted. Where such restrictions cannot be imposed, it seems desirable that a location be chosen for the loudspeaker where changes in room acoustics will have a minimum effect. This suggests that the speaker be mounted forward and above the mixing console, where it would be impossible for anyone to come between it and the engineer or the producer.

If a recording system is set up with variable equalization available to the engineer, it seems logical that the tap-off for the monitoring system should follow that equalization. Between the tap-off point and the recording cutter, the only equalization that should be permitted —in addition to the decompensation required for the pre-emphasis—is that which is fixed or semi-fixed for compensation of the cutter, or for processing losses. Similarly, no variable equalization should be permitted in the monitoring system, except that which is adjusted with the aid of a soldering iron. If level adjustments are available at the console, some loudness compensation should be added automatically. Since the final product is dependent on what is heard in the monitoring room at the time of recording, the monitor system is of prime importance, and should receive at least as much attention as any other part of the installation.

Both amplifiers and speakers should be set up on the basis of a standard playback curve, and should be most carefully maintained in accordance with those curves if there is to be any standardization of the product. The Standard Playback Curve recently adopted by the Audio Engineering Society is ideal for the electrical circuits. The choice of speaker, housing, and location should be made after thorough tests, and after the acoustic output of the speaker in its selected location is carefully assessed. Only by attention to every detail can a consistent product be expected from any recording studio.

Beyond that . . .

The Editors and Staff of Audio Engineering wish you a very Merry Christmas and a Happy New Year.

Design, Construction and Adjustment of

Reflexed Loudspeaker Enclosures

DAVID W. WORDEN*

Practical procedure in the planning for a reflexed speaker cabinet, with constructional hints which will simplify the work of building.

UNLIKE THE EXPONENTIAL HORN, multiple speaker, and large or "infinite" baffle arrangements, the reflexed enclosure is a resonant device. If the resonant frequency of the enclosure is made equal to the frequency of the loudspeaker cone resonance, a cancellation of resonant effects occurs and the result is smooth response down to a frequency somewhat lower than the loudspeaker would otherwise reproduce. Furthermore, the speaker diaphragm works into a favorable acoustical impedance, which means increased efficiency, reduced distortion and improved transient response. The damping characteristics of this enclosure are inherently rather poor, but a liberal use of sound absorbents—necessary for good cancellation of resonant peaks—results in excellent damping. A further advantage is its compactness and flexibility of physical shape and size.

The speaker resonant frequency determines the low-frequency cutoff of the system, since there is naturally a limit as to how far the response of the system will extend below this frequency. Hence the speaker should be chosen which has a low resonance; if response down to 30 cps is desired, the speaker should resonate at around 60 cps or less. Hence for best results 12- or 15-in. drivers are preferred, although the performance of any speaker will be greatly improved with a properly designed enclosure.

The reflexed enclosure is nothing more nor less than a cavity resonator of the type developed by H. Helmholtz. Referring to *Fig.* 1, it consists of an enclosed volume of air V coupled to the outside by means of a mass of air M in an open tube, or port. The magnitudes of V and M determine the resonant frequency. The operation is analogous to that of a parallel tuned circuit.

The volume, V, and the mass, M, of air in the exhibit acoustical reactance (capacitive and inductive, respectively) just as do their electrical counterparts. Also, similarly, the Q of the circuit is determined by the amount of resistance present, the acoustical resistance being supplied by sound absorbent lining inside the box and by curtains of burlap or similar material stretched across the port. The impedance of such a parallel tuned circuit is maximum at resonance.

The speaker is also a resonant device. The moving parts (cone and voice coil) and their suspension are mechanically equivalent to a weight acted upon by a spring. Such a system behaves like a series resonant circuit, which shows minimum impedance at resonance. Hence if the two systems be connected together and adjusted to resonate at the same frequency, the impedance "peak" of one fills the "valley" of the other and the combination tends toward constant impedance over a broad range of frequencies. If the resistive element, Q, of one of these circuits is adjustable, the cancellation of resonant effects can be brought about more closely.

The simplified equivalent circuit of the combination of speaker and enclosure is essentially as shown in *Fig.* 2.

Phase Effects

The question is often raised as to the phase of the signal issuing from the port relative to that from the speaker. The popular belief that phase shift in the reflexed box is due to internal reflections, and hence to greater path length, must be discounted in view of the fact that—with the usual box dimensions—path length could not possibly account for more than 20 deg. or so around 60 cps. The phase shift is due rather to the nature of the resonator, which may be considered as a closed organ pipe with lumped constants; the enclosed air, V, must always be a node and the air, M, a loop. (Note that no overtones are possible, in contrast with the organ pipe.) One quarter wavelength then must exist between node and loop, which means 90 deg. phase shift. This is sufficient to give an additive component, even if the signals from port and cone are equal; however, near resonance, the stiffness of the enclosure limits the cone amplitude to a very small value, and the radiation is almost entirely from the port. Furthermore, the output of a loudspeaker contains, near resonance, a strong component at 90 deg. with respect to diaphragm velocity, which would be in phase with the enclosure output. Thus the phase relations are favorable regardless of the shape or proportions of the box.

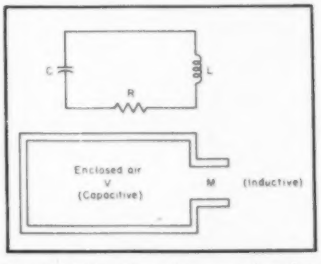


Fig. 1. Reflexed enclosure reduced to Helmholtz resonator equivalent, with electrical circuits corresponding to the acoustic network.

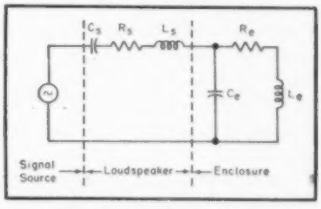


Fig. 2. Simplified electrical equivalent of loudspeaker mounted in reflexed cabinet.

The large reduction in loudspeaker-generated distortion is due to the restriction of cone amplitude mentioned above. Henney[1] shows the maximum distortion in an open-back cabinet of 43 per cent to be reduced to a maximum of 12 per cent in a reflexed enclosure. This represents a reduction in distortion of over 72 per cent.

Design Procedure

Lord Rayleigh presents the following formula for the frequency of resonance

* *Engineering Department, Consolidated Vultee Aircraft Corp.*

[1] "Radio Engineers' Handbook," 3rd. Ed. McGraw-Hill Book Co., New York.

(*Theory of Sound, Vol. II*), for an enclosure of the type shown in *Fig.* 3.

$$f = \frac{c}{2\pi}\sqrt{\frac{A}{V\,(L + \tfrac{1}{2}\sqrt{\pi A})}} \qquad (1)$$

where

f = resonant frequency, cps.
c = velocity of sound, in./sec.
$\pi = 3.1416$
A = area of cross section of port, sq. in.
V = net internal volume of enclosure, excluding volume of port, speaker, sound absorbents, etc., cu. in.
L = port length, in.

The velocity of sound is approximately 13,560 in./sec. at 70° F. Using this value, combining constants and solving for V, the formula becomes:

$$V = \frac{4.657 \times 10^6\, A}{f^2\,(L + .886\sqrt{A})} \qquad (2)$$

The first step is to determine the design frequency, f, which may be done in the following manner: with the loudspeaker in open air and connected to the output of an audio oscillator, vary the frequency slowly from about 30 to 150 cps. Note the frequency at which the cone amplitude is greatest. The peak may be rather broad; so run across it several times, noting the frequencies above and below the peak at which the diaphragm motion noticeably decreases, and average these two readings. Bits of paper torn up and placed on the cone may assist in observing the amplitude of the cone movement.

A better method, particularly with small speakers, is to isolate the signal generator and voice coil by means of a series resistance several times the nominal voice coil impedance, and read the voltage developed across the voice coil with a good a.c. rectifier-type voltmeter. These readings may be plotted against frequency and the resonant peak may be read accurately from the graph. This method is also the best for testing the completed enclosure.

Now that f is known, there remain an infinite number of combinations of V, A and L which would yield the desired result. A value for A may be arbitrarily chosen; it should be from one half to one times that of the speaker opening. Past practice seems to indicate this choice; at least, a number of successful enclosures have port areas within this range. The larger area is preferable since it radiates more sound energy, but, if it is too large the internal dimensions of the box may approach quarter wavelength, since the volume increases with port area. The area of the speaker cone may be computed from:

$$A' = \pi S\left(\frac{D+d}{2}\right) \qquad (3)$$

where

A' = speaker cone area, square inches
S = slant height of cone, inches
D = diameter at outer edge of cone, inches (do not include corrugations)
d = voice coil diameter, inches

From here on, the following procedure is suggested. Choose a value for A, say $A = A'$ to begin with. Set L equal to the thickness of the material of the box plus the absorbent lining, as this will be easiest to construct, then solve for V. Compare this computed volume with the space available, or cabinet size desired; and if it seems too large, either increase L or decrease A or both until a satisfactory compromise is obtained.

Box Shape

Now a word as to the shape of the box: the only restriction is that the inside lengths should be kept small in order to discourage air column resonances which may occur at frequencies where such dimensions are equal to a quarter wavelength. With the usual proportions, these resonant frequencies are high enough to be readily absorbed by the lining of the box, but if the enclosure were unusually long, trouble might be encountered. Also, the box will be inherently stronger and will require less material, the closer its shape is to a cube.

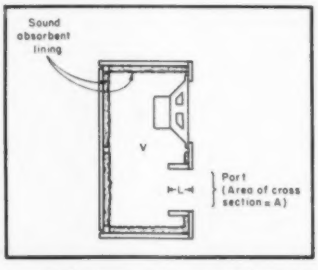


Fig. 3. Basic arrangement of ported cabinet using a port of finite length.

To the calculated net volume, V, must be added the volumes of the speaker itself, of that portion of the port which projects within the cavity, and of any other objects to be located within the box. The dimensions corresponding to the resulting gross volume will be inside measurements, and the thicknesses of the enclosure walls and lining must be added in order to obtain the overall dimensions. The volume displaced by the speaker may be estimated by computing the volumes of the cone plus a cylinder enclosing the magnetic structure. A table of approximate values is given below for convenience; however, individual speakers vary greatly, and actual measurements should be used whenever possible.

Nominal Speaker Size (In.)	Approximate Displacement (Cu. In.)	Approximate Cone Area (Sq. In.)	Approximate Resonant Frequency (cps)
6	10– 20	20	150–200
8	30– 60	38	100–150
10	70–140	60	70–100
12	100–200	85	60– 85
15	200–400	115	40– 65

The actual shape of the enclosure, if not dictated otherwise, usually develops in this fashion: the front face area is made large enough to accommodate the speaker and port comfortably, and its area computed. The gross inside volume divided by the (inside) area of the front face gives the required depth. The frontal area, port depth, or port area may be changed, if necessary, to adjust the depth to a satisfactory value.

An example may help to clarify the foregoing. Suppose a reflexed enclosure is to be designed around a 12-in. speaker which shows cone resonance at 70 cps. The cone area [A' in. Eq. (*3*)] is computed to be 85 sq. in., and this value will be used for A in Eq. (*2*). Now, assuming ¾-in. plywood for the box and ¾-in. lining, $L = 1\frac{1}{2}$ in. for the first trial. The net volume as computed from Eq. (*2*) is 8355 cu. in. Adding 200 cu. in. for the speaker gives a gross volume of 8555 cu. in.

The area of the front is estimated as

follows: the long side of the port may be made approximately equal to the diameter of the speaker cutout; this is economical in space and balances the appearance. The diameter of the speaker opening (and one side of the port rectangle) is 10½ in. The other side of the port opening is then $85/10\frac{1}{2} = 8.1$ in., or approximately 8⅛ in. (Great accuracy is not necessary, since the resonant frequency varies as the square root of the volumes, areas, etc., [See Eq. (*1*)]. Allowing 3 in. edge clearance and 2 in. between the speaker and port, the inside dimensions of the front will be $(3 + 8\frac{1}{8} + 2 + 12 + 3) = 28\frac{1}{8}$ in. long by $(3 + 12 + 3) = 18$ in. wide (speaker diameter is 12 in.). The frontal area is $(18)\ (28\frac{1}{8}) = 506$ sq. in. and the depth, then, must be $8555/506 = 16.9$ in. inside. Allowing 1½ in. for the wall thickness including lining, the outside dimensions become $31\frac{1}{8} \times 21 \times 19.9$ inches. Suppose, now, that the front dimensions are satisfactory but the depth is too great. The port length L may be arbitrarily increased, say to 4 in. The volume, Eq. (*2*), now becomes 6639 cu. in. net; adding 200 cu. in. for the speaker and 289 cu. in. for that portion of the port tube projecting into the enclosure, measured as shown in *Fig.* 4, the gross internal volume equals 7128 cu. in. The inside depth, then, is $7128/506 = 14.1$ in. or 17.1 in. outside.

Construction Notes

The box should be very rigid in order to resist vibration. All joints, corners, etc. should be strong and tight, preferably reinforced with strips, and large panels should be braced. The back should be attached with a liberal number of screws so that it may be removed to give access to the interior. If a pliable material such as hair felt is used for lining the enclosure, it may be attached to furring strips, thus spacing the lining away from the wood and increasing the low-frequency absorbtion. Take precautions against air leakage; the speaker gasket should seat against the wood, wiring should be brought out through a bulkhead type of plug or receptacle which may be mounted securely with screws, and the removable back panel should fit snugly. A good method for attaching the back is shown in *Fig.* 5.

Items of equipment may be located within the box provided they are not affected by the high pressures developed insided the resonator. Output transformers and dividing networks may be mounted in the box, but amplifying stages, for instance, might be subject to acoustical feedback if placed inside. Tweeter mechanisms should be well protected from this pressure.

Adjustment Procedure

Install the speaker in the completed enclosure and screw the back into place. Connect an audio oscillator to the loudspeaker input, and adjust the signal to a comfortable level. Now vary the frequency through the range below 200 cps, noting the frequencies of any peaks which may appear in the output. One of

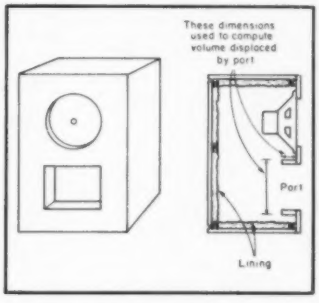


Fig. 4. Reflexed cabinet appearance, showing measurements to compute port displacement.

three conditions is likely to be encountered, as follows:

1. Enclosure frequency too high or too low. Two large peaks appear; one at loudspeaker resonance and the other at enclosure resonance.
2. Enclosure frequency slightly too high or too low. Two peaks appear, equally spaced above and below loudspeaker resonant frequency, but one noticeably stronger than the other. The enclosure frequency should be adjusted toward the smaller peak.
3. Correct tuning. Two peaks of equal amplitude, equally spaced above and below loudspeaker resonance.

The enclosure resonant frequency can be increased by decreasing the enclosed volume, V. A simple method for doing this is to place wooden blocks, such as might be cut from 4×4 material, inside the enclosure. These may simply be tossed in through the port while adjustments are being made, and fastened down later. The easiest way to lower the frequency is to decrease the port area, A, which may be done with strips of wood cut to fit along one side of the port, the width being equal to the port depth, L. These strips may be fastened in place with screws.

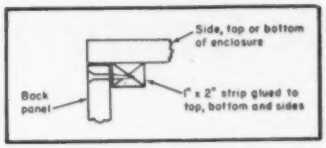


Fig. 5. Construction detail for corners of speaker cabinet.

When the frequency has been correctly adjusted, the damping may be increased by stretching porous cloth material (burlap, etc.) over the port opening. Experiment with various weights and layers of cloth until the two peaks just disappear. Too much damping will cause the single peak at speaker resonant frequency to appear.

As an alternative to merely detecting the resonant peaks by ear, a voltmeter may be used as described previously, and the response curve plotted.

It may be advisable to recheck the frequency adjustment after the system has been in use for some time. Loudspeakers, particularly when new or recently reconed, tend to show a lower value of resonant frequency after a period of time due to the cone suspension becoming more pliable with use. The loudspeaker resonance may always be found by blocking off the port and exploring with the audio oscillator. The only peak which shows up with the port blocked is that due to the loudspeaker cone resonance.

One more requirement is that the amplifying equipment used to drive this speaker system be capable of good frequency response, low distortion, and low output impedance. Then, a correctly adjusted and well damped reflexed enclosure will add greatly to the "presence" effect by providing extended bass response that sounds full and true without the usual resonant "boom" or "rain barrel" effect. Percussion instruments, plucked strings and other signals with high transient components come through clean and sharp because of the excellent response to such signals. In short, the improvement in overall performance due to the enclosure is great enough to more than justify the labor and expense involved.

A Continuously Variable Loudness Control

E. E. JOHNSON*

A new approach to the problem of adjusting frequency response simultaneously with changes in level in order to compensate for varying sensitivity of the ear.

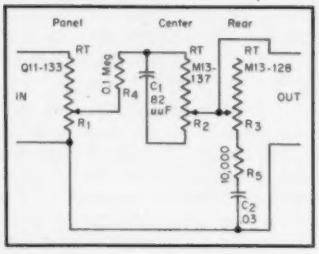


Fig. 1. Schematic of new loudness control which may be assembled from standard parts.

IT IS WELL KNOWN in audio circles that the human ear is very sensitive to both low and high frequencies at reduced volume levels. The accepted standard used in compensating for this hearing deficiency in audio systems is a set of curves at different levels known as the Fletcher-Munson curves. These curves show the amount of low-frequency and high-frequency boost that is required above some mid-range level to make the sound output of an amplifier appear balanced at all volume control settings.

Many attempts have been made to obtain the required compensation by use of single or multiple tapped volume controls, stepped loudness controls, and various types of bass and treble boost circuits. None of these has given the performance of a truly continuously variable loudness control. The tapped volume control affords compensation only when its contactor is at the tap but does not provide proper compensation when located away from the tap. To obtain wider spread of compensation, two or three taps are used, but such controls are more difficult to manufacture and, therefore, are more expensive. The stepped type loudness control does not provide full flexibility of adjustment and is relatively expensive. The bass and treble boost circuits require multiple adjustments with change of volume for ideal compensation.

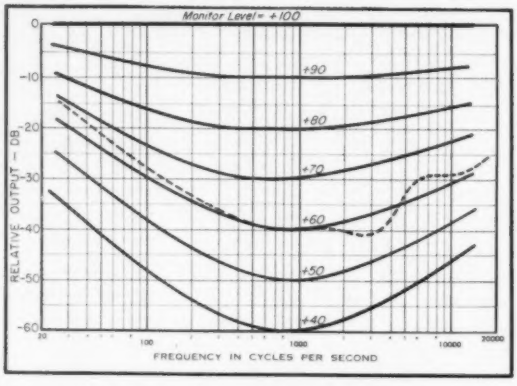


Fig. 2. Response curves for control at various level settings.

The control described in this article is a continuously variable loudness control that may be assembled easily from standard parts available widely from radio parts distributors. It may be wired into most audio systems as easily as an ordinary volume control.

Description

This new loudness control consists of three variable resistance units—R_1, R_2, and R_3—operated from one common shaft and in combination with the proper resistors and capacitors, as shown in *Fig.* 1.

The panel section R_1 functions as a standard volume control supplying a variable voltage to the other sections which form the frequency-compensating networks. The center section R_2 forms one variable leg of a potentiometer circuit and the rear section R_3 forms the other leg. Fixed resistor R_4 acts as a limiting resistor to keep the input impedance as constant as possible when the control is set near maximum output. The center control in combination with capacitor C_1 forms the arm of the variable voltage divider network which decreases in impedance as the frequency increases, causing the output voltage to rise at frequencies above 1000 cps. The response curves for this control at various settings are shown in *Fig.* 2. The monitor level figures represent the actual listening level at which the compensation most closely follows the Fletcher-Munson curves, one of which is shown dotted for a level of +60 db. (Normal listening level in the average living room will range from +65 to +75 db.)

The rear section R_3, fixed resistor R_5, and capacitor C_2 form the arm of the variable voltage divider network that increases in impedance as the frequency is decreased, causing the output voltage to rise at frequencies below 1000 cps, as shown in *Fig.* 2.

This arrangement offers a truly continuously variable loudness control that can be used to improve the sound quality of many radio, FM and TV receivers, as well as many sound systems. It must

[*Continued on page 40*]

*Engineer, International Resistance Company.

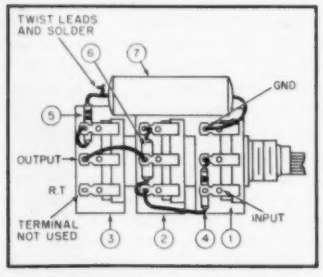


Fig. 3. Pictorial schematic showing exact wiring of components.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COVER

Construction of the new antenna tower for the top of the Empire State Building is proceeding rapidly, and the antenna is expected to be in use early in 1951. This photograph was taken from the top of 10 East 40th Street by Omar Marcus.

CBS Television Studio Intercommunication Facilities

ROBERT B. MONROE

A complete description of the facilities required to make possible the direction and control of personnel in the production of a TV program.

ONE OF THE OUTSTANDING differences between an aural and a television broadcast is the number of technical and production personnel required in the broadcast studio. In the case of an aural broadcast, as a rule, three or four persons are involved. In a television broadcast, on the other hand, a considerably larger staff is required. Included are the director, assistant director, studio floor manager, announcer, video switcher, audio mixer, cameramen, camera-control operators, sound-effects operator, microphone boom operators, studio lighting operator, telecine projectionist, telecine camera-control operator, and others.

With such a large staff, it might be expected that considerable confusion would exist in the television studio. However, anyone who has observed the production of a program in a well designed and well equipped television studio has noted that the operation is unusually well coordinated with little, if any, confusion or misunderstanding on the part of any of the staff. The reason for this smooth functioning and good coordination lies in the use of an intricate system of studio intercommunication whereby each member of the staff is cued and directed in his activities.

In the past, the design of TV studio intercom facilities has often been looked upon as a minor task that could quickly be dispensed with after all important design details of the audio and video facilities had been completely worked out. It is now generally recognized that the TV intercom facilities represent one of the major elements of the TV studio plant. Furthermore it is realized that the equipment arrangement and circuitry of these facilities can become quite complex. The TV intercom facilities should, therefore, receive the same careful planning and attention to design detail as is accorded to the audio and video facilities of the plant.

It is the purpose of this paper to discuss the philosophy underlying the design of television intercom systems and to describe briefly some of the facilities which have proven satisfactory in CBS TV studio operations. It must be recognized, however, that television is a dynamic, fast growing industry, and the requirements demanded of the intercom facilities are likely to change as the art progresses.

DESIGN CONSIDERATIONS

The term "TV intercom," as used in this paper, includes any facility that conveys intelligence serving to aid, direct, or cue a member of the TV staff or cast in the performance of their duties. Obviously, this includes the spoken words of the program director as well as other key personnel in the control room. Not as obvious, but quite as important to many members of the staff, is the audio portion of the program material from which many cues are obtained. For example, the orchestra leader usually takes cues for his music from the dialogue of the program. The video picture monitor, although not commonly thought of as a conveyor of cues, also falls into the classification of an intercom device. In studio operations most of the staff depend on a picture monitor for information of one kind or another; the lighting operator to check the effectiveness of lighting effects, the audio operator to avoid boom-suspended microphones or microphone shadows in the picture, and the sound effects operator for synchronizing sound effects with studio action. Thus it can be seen that the intelligence transmitted via the studio intercom system will take the form of spoken words, audio program material, and picture program material. All three are needed to convey the intelligence necessary to coordinate the activities of the large group of technical, production, and performing personnel.

Robert B. Monroe, Project Engineer
CBS General Engineering Department

Born in Brooklyn, New York on October 17, 1908, Mr. Monroe attended Pratt Institute from 1937 to 1942 while being employed by Columbia Broadcasting System, Inc., where he went in 1934 and where he has since been continuously employed except for the war years.

From 1942 to 1945 he was associated with the Radio Research Laboratory, Harvard University (sponsored by the Office of Scientific Research and Development). He served successively as head of the Planning Department, head of the Standards Laboratory, and assistant to the Executive Engineer.

Mr. Monroe is a senior member of the Institute of Radio Engineers.

The staff in the studio control room, which includes the director, assistant director, camera control operators, video switcher, and audio mixer, usually carry on direct conversation without the use of any special intercom facilities. When the director speaks, all in the control room hear him, and if necessary, answer him directly. The monitoring loudspeaker permits all to hear the audio portion of the program. If the basic design principles of control room layout have been followed, all are seated in a manner providing good visibility not only of the outgoing line picture monitor but also the monitor associated with each individual studio camera. Therefore, it can be seen that the intercom facilities serve mainly to convey information to the staff outside the control room, and in some cases, permit them to talk to the control room. The staff outside the control room include those in the studio, those in an associated telecine room, as well as those at other points remote from the studio.

The Program Director

It is at the program director's desk in the studio control room, *Fig.* 1, that most of the coordination of a television program takes place. Because of the many responsibilities of the program director, it is very desirable that he be provided with the absolute minimum of equipment that he must operate. Ideally, all that should confront the director is a microphone; when he speaks, all concerned should hear him.

A TV intercom system should be designed to conform with this ideal situation as closely as possible, however, it has proven desirable to make some compromises and provide a few controls at the director's position for several special, although infrequent, operations described below. In addition, it has also proven desirable to provide a telephone jack into which a telephone headset or handset

Fig. 1 (left). The director's position in a CBS-New York television studio. Four of the key switches on the small control panel connect the director's interphone instrument to various interphone stations in the studio. Two other key switches connect his desk microphone to the studio talkback loudspeaker and to the telecine room intercom loudspeaker. The assistant director is equipped with identical facilities. Fig. 3 (right). The type of telephone headset shown is generally used by CBS cameramen and camera control operators. The microphone boom operator in the background is wearing a pair of split headphones by means of which he receives instructions and cues.

can be plugged to permit the director to participate in two-way conversations with the studio cameramen or with other points equipped with two-way telephone facilities. It is good practice to provide the assistant director, who is usually seated immediately alongside the director, with independent facilities identical with those provided for the director.

The Interphone System

The only facility usually associated with the term "TV intercom" is the private telephone system mentioned above which provides two-way communication between control room, cameramen, and at times, other points. To differentiate these private telephone facilities from other studio intercom facilities, the telephone system may be referred to as the *interphone* system. The terminal equipment for these interphone facilities is usually supplied as an integral part of TV cameras and certain other video components, such as video switching units. When interphone stations are required at other points, the components may be procured and installed as desired.

In the case of TV field pick-ups, this relatively simple interphone system often constitutes the entire and only intercom facilities. While adequate for intercom purposes on the simpler type of remote pick-ups, these basic intercom facilities must be substantially augmented to meet the additional requirements encountered in TV studio operations.

Figure 2 shows, in simplified form, a typical studio interphone system of the type employed by CBS. It will be noted that the switching facilities permit either private camera-to-camera-control conversation, or a conference connection between all desired stations. The private camera-to-camera-control connection is useful in the routine alignment and maintenance of cameras. Should a camera fail during a rehearsal or air program, it is possible for the maintenance staff to work on it without interfering with, or being distracted by, other conversations on the interphone system. In the conference position, where all desired interphone stations are paralleled, a portion of the audio from the director's microphone circuit is introduced into the interphone system permitting all stations to hear the director even though he is using a desk microphone rather than an interphone instrument. It is desirable to adjust the level from the director's microphone so it reproduces several decibels higher in level than other interphone conversations. By doing this the director's comments override and take priority over other conversations.

Should the director desire to engage in a two-way conversation with one of the interphone stations in the studio, he may employ an interphone instrument although this is usually only necessary when the studio is on the air. During rehearsals persons in the studio can be heard in the control room by means of the studio microphones and control room monitoring loudspeaker.

It is customary for the cameramen and camera control operators to employ telephone headsets of the type shown in *Fig. 3*, as this type of headset leaves both hands free for the many other operations they must perform. Some interphone systems employ headsets with two receiver units, one used with the interphone system, the other to reproduce audio program material. Most cameramen at CBS, however, prefer the single receiver type of headset as this leaves one ear free to hear directly what is happening in the studio. In this way they hear the aural portion of the program directly from the performers on the set. The camera control operators in the control room are served well by the single receiver type of instrument as they hear the audio portion of the program from the control room monitoring loudspeaker. For these reasons, the single headphone type of interphone instrument has been standardized at CBS.

Either the headset or hang-up handset type of instrument may be used by the director, assistant director, switcher, and audio operator depending upon the extent to which the interphone is used. A jack is provided at each of these positions to permit the use of either type. Currently the preference seems to be for the headset type of instrument.

Other Interphone Stations

In addition to the main interphone system connecting the cameramen, camera control operators, video switcher, and director, it is often advantageous to provide several interphone branch circuits permitting personnel in the control room to engage in conversation with certain members of the studio staff such as the studio floor manager, sound effects operator, and lighting operator. Thereby the director can work out special problems with the floor manager or can discuss lighting effects directly with the lighting operator. Similarly, the audio operator can discuss sound-effects levels or other problems directly with the sound-effects operator.

As described in the following sections, the floor manager, sound effects operator, and lighting operator receive their regular communication from other circuits and this telephone is an auxiliary facility for use in working out special problems, usually during studio rehearsals. For this reason, the hang-up handset type of instrument is preferred at the lighting and sound effects stations. A flashing light is used for calling, rather than a bell, to permit the calling circuit to be used when the studio is on the air. The floor manager uses the "production" headset jack, which is available in many studio cameras, when it is necessary for him to talk to the control room.

As can be seen in *Fig. 2*, these branch circuits are not a part of the main interphone system. When used, the station in the control room usually is dis-

connected from the main interphone system and engages in a private conversation with the branch station.

Headphone Cueing Circuits

The two-way interphone system, as noted above, serves mainly to provide continuous communication with studio cameramen and occasional two-way communication with other persons in the studio. It is necessary to provide continuous cueing circuits to other personnel in the studio, such as the microphone boom operators, orchestra leader, announcer, as well as the sound-effects and lighting operators. This is accomplished through the use of headphones which may be connected into receptacles which are provided at strategic locations

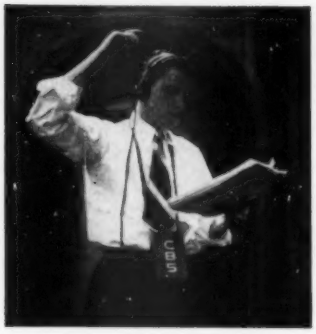

Fig. 4. Communication to the studio floor manager (as well as other studio personnel who must be free of the encumbrance of a wire connection) is accomplished by means of a low-frequency, induction-field radio circuit. One of the ultra-compact receiver units is shown in the above photograph.

throughout the studio. Unlike the interphone system which employs headsets with a single receiver unit, these headphones are equipped with two receiver units which have been wired to permit the reproduction of different information in each. These split-headphone cueing facilities are known as *headphone cue*.

It is necessary to provide two types of headphone cue. The first type is for the general use of technical and production personnel and, at CBS, is known as *regular* headphone cue. Regular cue reproduces the voice of the director in one of the two earphones and audio program material in the other earphone. The second type of headphone cue is specifically for the use of the microphone boom operators and, for that reason, is known as *boom* headphone cue. Like regular cue, boom cue reproduces the voice of the director in one earphone and audio program material in the other; however, the control room audio operator can break into the audio program side of the circuit and talk directly to the microphone boom operators at any time.

Radio Link

The interphone system and headphone cue circuits provide communication and cueing facilities for most of the studio technical and production staff. Both systems, however, require a direct wire connection and therefore restrict the movement of the persons at each end of the circuit. This is not a disadvantage in most cases since most of the studio staff are closely associated with equipment requiring other wire connections such as a camera, microphone boom, lighting panel, or sound-effects console. Other persons, however, notably the studio floor manager, must often be free to move to any part of the studio without the encumbrance of a cable yet must remain at all times within the range of the voice of the director in the control room. A radio circuit is provided for these persons. The receiver is an ultra-compact battery operated unit which is carried over the shoulder as shown in *Fig.* 4.

The radio link employed in CBS television studios is an amplitude-modulated induction-field system which operates with a power of a few watts in the low-frequency range between 100 and 200 kc. It is necessary to assign different frequency channels to systems operating in adjacent studios to prevent interference.

Some television studios have successfully employed radio cueing transmitters and receivers operating in the VHF portion of the spectrum. Such transmitters must, of course, be licensed.

In TV studio productions, portions of the program material often originate on motion picture film and still slides or opaques. This film and slide material is integrated into the live portion of the program in the studio control room. For practical reasons, all projectors and associated film camera chains are usually centralized in a special area known as the telecine room. The telecine room serves all studio units in the plant.

Because of the physical separation of the telecine room and the control room, it is necessary to provide adequate intercom facilities between the two points. As the motion picture projectionist must be free to move about in loading, unloading, and rewinding film, it is desirable to provide a loudspeaker reproducer rather than the telephone headset type employed in the studio. In CBS studios, it is standard practice to provide two-way loudspeaker service between control room and telecine room. The telecine loudspeaker must be capable of operation at fairly high level, considerably higher than the conventional office type intercom systems, because of the high noise level that exists when several projectors are in operation.

Inasmuch as the telecine room serves all studios, switching facilities must be provided at each camera to permit the projectionist to connect his intercom facilities to the particular studio with which he is working. He must also be equipped to select audio program material, video program material, and headphone cue (which may be used in the

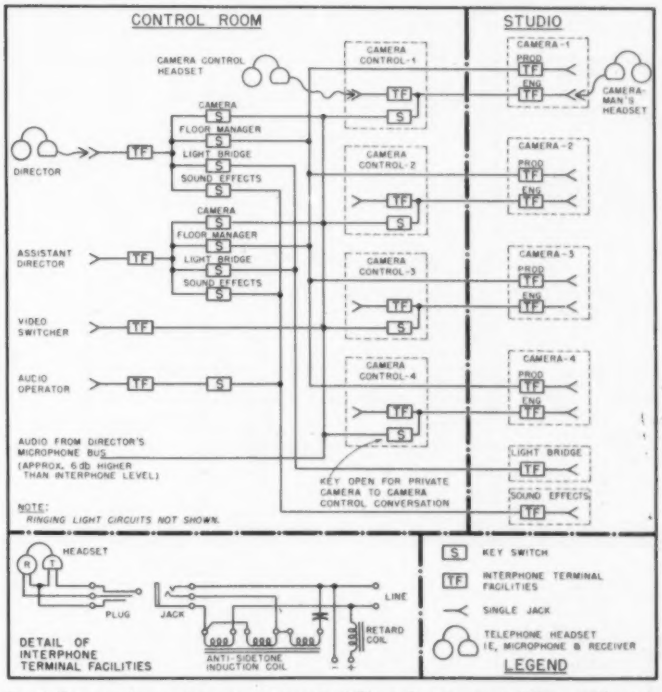

Fig. 2. The interphone system, one component of TV studio intercom facilities, provides telephone communication between control room and studio cameras as well as other points in the studio.

event of an intercom failure) from the desired studio. Furthermore, he must be equipped to extend control of starting and stopping motion picture projectors to the desired studio. His switching can be simplified by ganging as many of these functions as practicable on a single selector. In practice, it has proven desirable to gang the intercom circuits, audio program circuit, and headphone cue circuit on a single selector, and provide separate selectors for the video monitor and for projector extension control circuits. This permits him to control the projector and monitor the camera locally during setup yet maintain his intercom connection with the studio. A separate loudspeaker cueing circuit, similar to those employed on transcription turntables for cueing records, is provided when it is necessary to cue motion picture film aurally.

Duplicate intercom facilities must be provided at each of the telecine camera-control units unless these control units are located immediately adjacent to their associated film camera and projectors and can therefore make use of the same microphone, loudspeaker, and switch. These camera-control intercom stations may be equipped with independent studio selecting facilities or, if desired, the intercom facilities at both camera and camera-control may be switched by a common selector which may be located at either of the two points. The latter system is simpler but less flexible than the former method.

Although loudspeaker intercom reproduction has been found preferable at film cameras originating motion picture sequences, it has been found that headphone cue is more desirable for the operators of television optical projectors (telops), *Fig. 5*, which are used for originating opaque as well as transparent slides. This is explained by the much closer cooperation required between the operators of these telop machines and the control room. In the case of the motion picture projectors, the actual starting and stopping of projectors is done usually by the video switcher in the control room. On the other hand, the telop operator must set up, change, fade, and superimpose slides directly from the telop and must therefore carefully follow the director's instructions, as well as the program continuity, at all times. For this reason, the continuous flow of cueing information on the regular headphone cue circuit is more desirable, in this case, than the intermittent instructions intended specifically for operators of film projectors on the intercom loudspeaker. At the same time, the head-

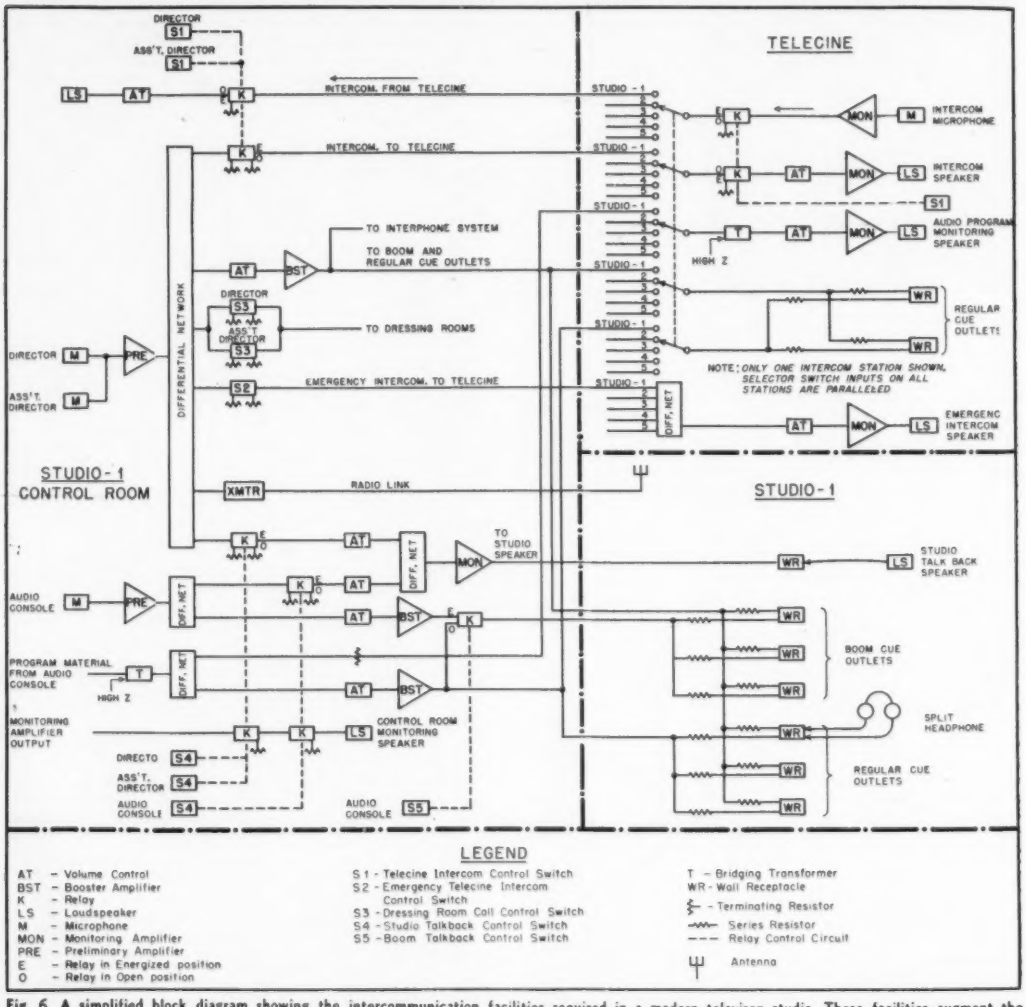

Fig. 6. A simplified block diagram showing the intercommunication facilities required in a modern televison studio. These facilities augment the interphone system shown in Fig. 2.

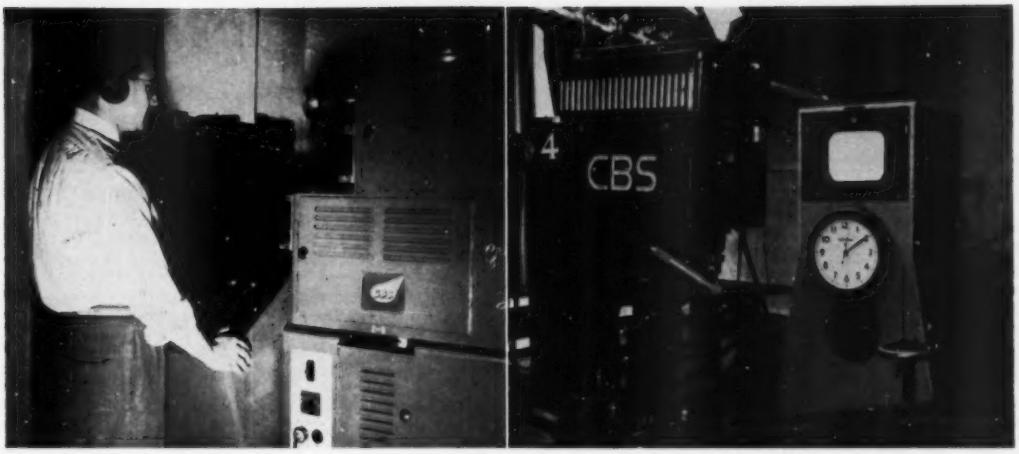

Fig. 5 (left). Operators of telop equipment in the telecine room receive instructions on cues on split headphones. They can talk to the studio control room by means of the microphone mounted near the top of the projector. The intercom control panel, lower right, contains a talkback key switch, a studio selector switch, and two headphone receptacles. Fig. 7 (right). The CBS studio floor monitor shown above is a mobile unit containing a picture monitor, a loudspeaker, and a clock.

phones tend to close out distracting sounds and permit the telop operator to concentrate on his work. The same facilities are used to talk to the studio from the telop projectors as are used in the case of the motion picture film projectors.

Emergency Telecine Intercom Facilities

As already described, each film camera in the telecine room is provided with an intercom system which can be switched to operate with the intercom facilities in any desired studio control room. It is the usual practice for the projectionist to set this switch to provide communication with the studio with which he is to work. A problem often arises when another studio desires to communicate with telecine (for example during routine maintenance or for a special test) and the intercom selector switch in telecine is not set to communicate with that studio. Similarly, the same difficulty would be encountered had the telecine operator forgotten to set up this switch or had inadvertently set it to the wrong position.

One way of establishing communication under these circumstances would be for the studio to call telecine on the regular telephone; however, this is not desirable as the need for communication with telecine may well be urgent and the telecine extension is often busy with other calls. For this reason, it has proven desirable to provide an "emergency" telecine intercom system.

The emergency telecine intercom facilities consist simply of one or more loudspeakers installed where they are clearly audible throughout the telecine area. These loudspeakers are driven by an amplifier of adequate size to produce the necessary sound level. Facilities in each of the studio control rooms, shown in *Fig. 6*, connect the director's microphone to the input of this amplifier whenever a control room key switch marked TELECINE EMERGENCY is operated. After the attention of the telecine operator has thus been attracted by his emergency circuit, he can set up the regular intercom circuit which will provide the desired two-way communication.

Loudspeaker Talkback to Studio

The facilities described thus far provide aural communication and cueing circuits for all technical and production staff concerned with a television studio production. Communication to performers in the studio is accomplished during radio rehearsals through a talkback loudspeaker. This talkback circuit, which is similar to those employed in aural broadcasting studios, permits the program director or his assistant to direct the activity of the performers at any

[*Continued on page V13*]

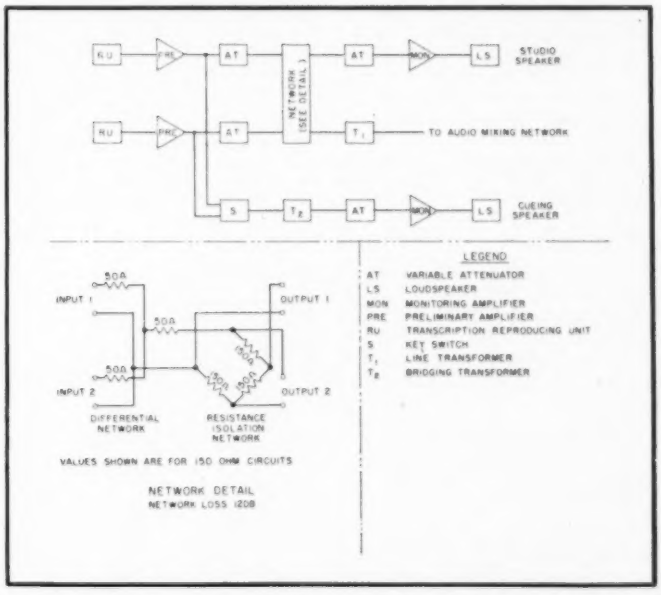

Fig. 8. The circuit arrangement employed to transmit transcribed program material simultaneously to both a studio loudspeaker and the audio program line. The resistance isolation network serves to prevent studio microphone program material in the audio mixing network from reaching the input to the studio loudspeaker amplifier. Without the isolation network, acoustic coupling between studio microphones and studio loudspeaker would result in singing.

Audio Systems For TV Service

W. L. LYNDON*

A discussion of the equipment necessary for use with a single-studio TV installation capable of presenting live programs in addition to transcribed and network shows.

THE PREVIOUS ARTICLE in this series was devoted to the description of a simple audio-video switching unit, RCA Type TTC-3A1, which would permit a television system capable of handling only film, slides, and network programs to be placed on the air with a minimum outlay of equipment. Consideration shall now be given to the audio equipment requirements for a television system having a single studio, an announce booth, and facilities for handling film and remote or network program service. The lineup of audio equipment required for such an installation does not vary greatly from that of a comparably sized AM or FM installation; the main differences are the additional facilities necessary for handling the audio output of the film projectors and a communication system to be used by the program director for coordinating the program sequences.

This audio system is based on the use of standard stock speech input units and consists of three main items:

1. One 76B5 Consolette
2. One BCS-3A Control Unit
3. One rack of Speech Input Equipment

This arrangement is capable of switching, mixing, and monitoring the following program sources:

1. Studio
2. Announce Booth
3. Film
4. Transcription
5. Network and Remotes

Loudspeaker monitoring facilities are provided in the main control room, studio, announce booth, and projection room. The speaker in the studio serves as both a cue and talkback speaker. The studio speaker is also tied in on an override circuit which will permit transcriptions or sound effect records to be heard in the studio during "on-the-air" operation.

In order to simplify the description of this system, reference should be made to *Fig.* 1, a single-line block diagram of the 76B5 consolette which is employed as the system's basic unit.

The Consolette

It will be noted that the consolette has four pre-amplifiers feeding into a six-position mixer system. Two of the mixers are connected through isolation line coils to six-position mechanically interlocked line switches. The program level from the remote lines, after equalization, and from the two turntable positions, is controlled by these two mixers. Each of the six mixers feed into a lever key which will permit placing the circuit to either a program or an audition bus. This feature permits circuits to be monitored before being switched to the program bus. These lever switches associated with the mixers are tied in with the studio cue and talkback circuit. When they are in the PROGRAM position, the talkback or cue circuit cannot be operated. In the normal OFF position, program is automatically fed into the studio. In the audition position the talkback circuit between the control room and the studio can be operated. The program bus contains a program amplifier equipped with an interstage master gain control and has a normal output rating of + 18 dbm with 0.5 per cent distortion from 50 to 7500 cps, and a maximum output level of + 26 dbm with 1 per cent rms distortion over the same frequency range. Across the output of this amplifier is located a standard VU meter with an adjustable input control. This meter is also capable of indicating the plate current of each amplifier tube located in the program channel.

The monitoring amplifier located in the audition channel is provided with considerably higher gain and higher power output in order that it may be used in conjunction with a talkback circuit and also to provide sufficient volume for the speaker system. There are three speaker control relays located within the consolette and in this TV system they are used in conjunction with the control room speaker, studio speaker, and headphone monitoring for the microphone boom operator. The additional relays required for the projection room and announce booth are mounted on the rack equipment along with the AUDITION and ON AIR studio signal light control relays.

The input to the monitoring amplifier is terminated in a row of mechanically interlocked push-type switches which select the circuit to be fed to the input of the amplifier. This includes the audition position, talkback circuit, and five "cue" line inputs. Two of these "cue" positions are used in this television audio system to monitor the output of the two equalized remote line circuits.

The power supply for this consolette is a self contained unit housed in an electrically interlocked cabinet with the rectifier chassis so constructed that it may be readily hinged out for servicing. This unit is normally mounted at a point remote from the consolette and interconnections made by suitable shielded leads.

Figure 2 is a single line block diagram indicating how the consolette and the external units are combined to make up this TV audio system. The studio is shown as having a total of eight microphone circuits, four of which are normalled through jacks on the speech input rack to the consolette preamplifier inputs. The remaining four positions are terminated on jacks to be patched into the circuits as required.

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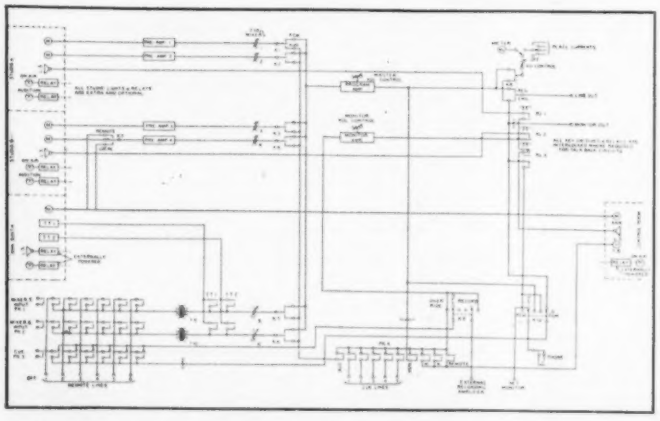


Fig. 1. Block Diagram of 76B5 consolette used for small station operation.

Fig. 3 (left). Typical station installation employing the audio system diagrammed in Fig. 2. The audio units are located on a higher level in order that the audio operator has visible access to the video monitors and to the studio. (Courtesy WENR-TV) Fig. 4 (right). This station also employs the audio system of Fig. 2, but is arranged differently. Note turntables at left, audio TV control at center, program director's console, and camera units at right, forming a single operating unit.

Microphones

The quantity and types of microphones to be used is generally determined by the type of programming that is contemplated. Simple productions usually involve simpler microphone technique and many presentations can be handled very effectively with one microphone placed on a movable boom stand with possibly one additional floor-stand or desk microphone for commentary or announcement purposes. Productions of a more complex nature—such as dramatic presentations where more than one set is involved—present a greater problem and to do the job effectively and have the microphone in the right place at the correct time requires the use of a quiet, highly flexible boom stand having a large range of extension with a wide vertical and lateral swing. There are two types of microphone boom stands in general use today for television service. One of these is a semi-adjustable type which can have its extension and elevation adjusted beforehand and then wheeled into position. This type of stand can be used quite effectively on such production that will permit the microphone to be placed above the scene being televised and not requiring any extensive movement of the microphone during the show.

Shows of a variety or dramatic type where there is considerable movement of the artists require a boom stand that will literally permit the microphone to follow them around the set. This type of stand is in general use in the motion picture industry and one model recommended for TV programming is the MI-26574. This particular stand provides an operating station for the boom operator and the whole structure is mounted on rubber tired wheels which permit it to be readily moved across the floor. The length of the boom can be extended from 7 to 17 feet, and the microphone can be "gunned" through an angle of 280 deg. This boom stand, in the hands of a trained operator, can do much to offset the disadvantages of picking up sound at a greater distance from the source than is encountered in the regular AM or FM system of broadcasting. In selecting this latter type of stand, consideration should be given to the size of studio in which it is to be operated. In small stations where staging space is at a minimum, it would be more practical and more economical to use the semi-adjustable stand.

Microphones that are used for broadcast service can also be employed for television programming. The microphone generally recommended for boom service is the type 77D. This is basically a ribbon microphone operating on a velocity-pressure principle. It has three directional characteristics, namely: uni-directional, bi-directional, and non-directional. For boom service it is generally set in the uni-directional position, which will permit artists to operate at a greater distance from the microphone and its directive characteristic will favor reduction of reverberation and background noise level.

Monitor and Signal Circuits

The studio monitor speaker serves three functions, namely:

1. Talkback
2. Cue or Monitor
3. Effects Speaker

The latter circuit permits sound effects records or transcriptions to be fed into the studio for special effects purposes while it is "on-the-air".

Relays are included in the rack equip-

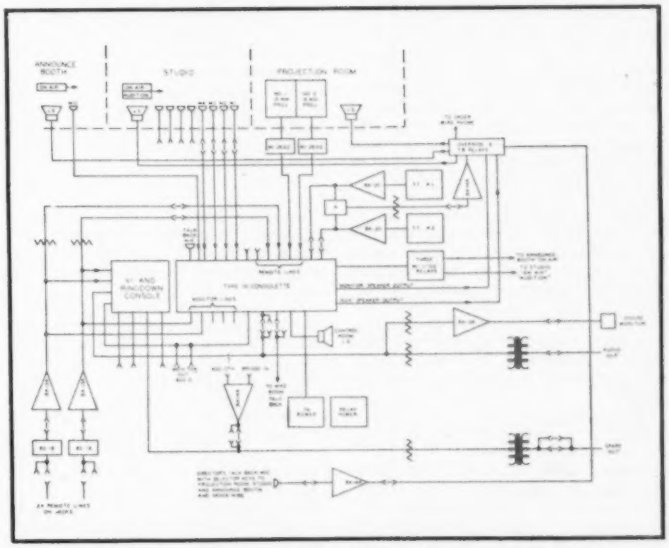


Fig. 2. Block diagram of complete audio installation suitable for a small TV station.

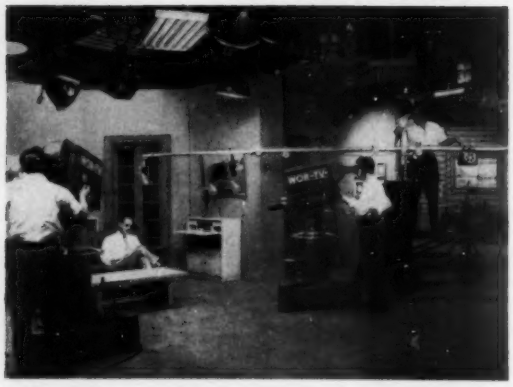


Fig. 5. A flexible and easily operated boom stand is an invaluable piece of TV studio microphone pickup equipment.

(Courtesy WOR-TV)

ment that will permit the operation of an ON AIR studio signal and AUDITION lights.

The equipment required for the announce booth consists of an announce microphone, a monitor loud speaker, and ON AIR signal light. Any of the previously mentioned microphones may be used for this service. When the studio is "off-the-air", program is automatically fed into the announce booth. The operation of the ANNOUNCE key on the consolette places the microphone in the circuit, opens the monitor speaker circuit, and turns on the ON-AIR signal light.

The output of this announce microphone circuit may be fed directly through the consolette to the line as, for example, in supplying commentary for slides or silent motion pictures, or it may be mixed with the output of the sound from the studio, motion picture projectors, the remote line circuits, or, if necessary, may be mixed with the output transcriptions.

The audio equipment for the projection room is of minor nature. Stations of this size would normally use two type TP-16B 16-mm projectors whose output level is +4 dbm. This should be attenuated to approximately −20 dbm before being fed into two of the remote line positions on the consolette. Due to the fact that considerable variation in frequency characteristic is likely to be encountered from the various types of films that may become available for television use, it is recommended that an MI-26313 equalizer be employed in the audio output of each projector. The equalizer has three bass and three treble boost positions as well as three bass and three treble attenuator positions, in addition to a flat response position. This equalizer is a "T" network and should be isolated from the input of the consolette by means of a line coil in order to obtain correct performance from the equalizer.

The loudspeaker serves as a monitor speaker and is tied in with the program director's talkback system.

In order to provide facilities for handling network and remote program circuits, two type BE-1B line equalizers and two type BA-13A studio amplifiers are included as part of the rack equipment. The line equalizers are capable of equalizing normal program line circuits up to and including 15,000 cps. The studio amplifiers have sufficient gain to bring the equalized line levels up to such an output that they may be read on a standard VU meter. This permits the lines to be equalized and level adjusted before being placed on the air. The outputs of the BA-13A amplifiers are fed through a fixed attenuator pad to two of the remote line positions on the consolette, as well as to two of the monitor inputs, thus permitting complete remote-line checking before going on the air. There are a sufficient number of jacks located on the rack to permit the termination of a maximum of 24 remote line circuits.

Transcription service does not play as important a part in television broadcasting as required for AM or FM broadcasting, yet such facilities must be provided for producing background music, fill-in for slides and silent motion pictures as well as sound effects. This system employs two type 70D turntables. The output of each machine feeds into a type BA-2C preamplifier and then to the transcription inputs of the consolette. Across the outputs of the preamplifiers is located a two-way lever key switch which will permit the signal to be fed to the input of a BA-14A monitoring amplifier. This key switch also operates a relay which will permit this signal to be fed to the studio loudspeaker. This feature makes it possible for records to be used for dance purposes, accompaniments, and sound effects. The transcription service can also, at the same time, be fed through the consolette channel to the line.

The regular line output position of the consolette is normalled through jacks and an isolation transformer to the outgoing line. This line is also bridged by another BA-13A amplifier which normally acts as an isolation amplifier to feed a house monitoring bus. It may also be used as a spare amplifier when required. A spare BA-14A amplifier is provided with its 600-ohm and bridging input circuits terminated on jacks. Its output is also normalled through jacks and a line coil to provide a spare line output circuit.

A standard consolette alone very seldom satisfies the complete requirements of a broadcasting installation, and a television system is no exception to the rule. In order to increase the flexibility of the system and provide additional features, a companion unit, BCS-3A, has been developed to mount adjacent to the consolette. It contains a standard VU meter with a calibrated input control and a ten-position selector switch. A number of circuits are normally connected to the input of this switch, such as the output of the two line amplifiers, the output of the spare BA-14A amplifier, and the regular output of the consolette. Across this switch is located a jack which will permit the use of a pair of headphones. On this panel is mounted the key switch for controlling the output of the two transcription turntables for the studio speaker over-ride circuit and a suitable volume control for the input of its associated amplifier.

A spare 250-ohm volume control is mounted on the console and its input and output circuits are terminated in line transformers whose 150/600-ohm inputs and outputs are terminated in jacks so that they may be patched into a circuit when so required. Located on the right side of the BCS-3A unit is a six position ring-down circuit, consisting of six relays, six indicator lights, and six ring-talk lever key switches. A jack is provided for inserting a standard telephone unit. These six input circuits are also terminated on jacks on the rack which permits them to be patched into the incoming lines as required. The power for operating the calling signal lamps is obtained from the 12-volt d.c. relay power supply. The ringing current is not supplied as part of this equipment. This intercom circuit, placed adjacent to the consolette, permits the operator to communicate directly with remote points without having to leave the equipment during a program.

In order that a program director may successfully produce a show, a means of dispatching information to a number of strategic points must be provided. To accomplish this, a separate talkback circuit consisting of a microphone, BA-14A amplifier, four relays and four control keys, is included as part of this system. The four lever key switches are to be located near the program director's point of operation. These circuits permit talkback to the following points by interrupting the program monitor circuit:

1. Projection Room
2. Studio
3. Announce Booth
4. Order Wire Circuit.

The order wire circuit is normally connected into a video switching unit such as a TS10A switching panel, which also provides a two-way phone circuit between the camera operator and the video operator.

The various amplifiers, equalizers, relays, isolation transformers, and six jack strips are assembled and wired in a standard cabinet rack which may be mounted as a single unit or in line with other equipment racks that are required

[*Continued on page V14*]

Remote Television Broadcasting

W. I. McCORD

Continuing the description of the DuMont Telecruiser to cover the video phase of remote pickup operation with this versatile "portable studio."

AT THE PRESENT TIME, in television broadcasting, there are many schools of thought regarding the manner in which various types of programs should be handled. After having carefully studied all of these various ideas, we have designed the Du Mont Telecruiser which is engineered for efficiency and versatility. It is a complete television studio on wheels, transporting men and equipment to the scene of action. Its arrangement is quite flexible and allows the use of the Telecruiser either as a mobile vehicle or as an adjunct to studio operations. Many of the smaller stations who use the same equipment for remote operations and studio pickup have made provision for the Telecruiser to be driven into the studio area or adjacent to it and operate the Telecruiser as a studio control room. This manner of operation requires only the removal of the cameras from the Telecruiser and the playing out of the necessary amount of camera cable to connect with them. Handling of the equipment is thus minimized, and the Telecruiser is ready to roll in a few minutes time making possible close scheduling between studio programs and remote pickups. Also, this system makes it possible to use other large auditoriums or buildings, such as municipal stadiums, armories, halls, and so on, for studio operations that cannot be accommodated in the small area of the station's own studio. Television broadcasters who plan to use the Telecruiser for more than one of their stations dispatch it from station to station as needed. Also, it is possible to rent out the facilities to stations in the near vicinity thereby deriving some revenue from time when the Telecruiser would normally be inactive.

Being completely self-sufficient, the Telecruiser can readily be used advantageously for picking up special events or to cover emergencies at a moment's notice, providing a source of "on the spot news coverage," such as the televising of a fire, train wreck, floods, flood conditions, or other catastrophies. These scenes can be transmitted over the microwave relay back to the station, where they may either be rebroadcast to home receivers immediately, or through the use of the tele-transcription (recording on film) at a later time so as not to interfere with a scheduled show.

Willis I. McCord, Manager,
Television Specialties Department of the Research Division, Allen B. Du Mont Laboratories, Inc.

Complete equipment is transported on the Telecruiser to cope with any conditions which might be encountered in this line of work either for daytime or night operations.

Every effort has been made in designing the unit to minimize the time and labor required to set up for a television program and to replace equipment in the vehicle at the close of operations. The savings effected by labor-saving devices result in less overtime hours and require fewer operators than would otherwise be necessary. The morale of operators working in a unit which is so planned and arranged is a big factor and results in better employer/employee relationship and improved picture quality. Employees take more pride in the appearance of their equipment and will be more careful not to damage or abuse it. As a result, there are fewer instances of equipment failure and the station owner has the satisfaction of seeing his investment and capital equipment being protected.

Description

The basic vehicle which is used as our Telecruiser is a bus-type vehicle having been selected for its maneuverability, riding quality, and streamlined appearance. It is a Flexible Coach, 30 ft. long and 8 ft. wide, and with 9 ft. 3 in. overhead clearance. The wheelbase is 182 in. with a turning radius of 38 ft. 5 in. It is powered with a Buick 150 h.p. Fireball engine mounted in the rear and is equipped with Bendix Westinghouse air brakes and all other standing road equipment to meet State and ICC regulations. All replacement parts are of standard manufacture available any place in the country. The vehicle is capable of over-the-road speeds up to 70 miles per hour and can negotiate rough road conditions. In many cases these units have been driven over open fields where one would hesitate to take an automobile. The short wheelbase makes possible getting the vehicle into small confined areas and the exceptionally low overhead clearance has many times allowed us to use the Telecruiser in places where it would have been impossible to take a higher unit.

The interior of the Telecruiser has been arranged to accommodate a triple image-orthicon chain transported in operable condition with all cameras, tripods, and cables quickly accessible. Three main sections divide the interior as follows: (1) Driver's compartment with provision for transporting personnel in comfortable seats. (2) A control room compartment containing the audio console director's desk and video operating console. (3) Storage compartment containing cable reels, camera tripods, microwave relay transmitter and parabolic reflector, lighting equipment and a 5-kw gasoline-driven generator to provide 120-volt 60-cps a.c. power.

The control room is the largest area and arranged so that the video console runs crosswise of the vehicle. Seated in comfortable operating chairs in front of this console are three video control operators. One of these operators is the switcher or technical director, who is responsible for the selection of the proper picture to feed to the phone line or microwave relay. On the top of the console, four units are mounted. Three of these units are identical individual camera control monitors, each one coupled directly with its associated camera and displaying the picture coming from that camera. The fourth unit is the mixer monitor and amplifier which contains the switching buttons and can accommodate up to four cameras. The special effects are controlled by this unit and the switcher can lap fade or superimpose the pictures. The lap and fading from one camera to another can

Fig. 1. The KBTV Telecruiser in use on location with the microwave relay "dish" in operation on its collapsible tower.

be done either manually or automatically with varying time rate, i.e. instantaneous, slow, medium, or fast, set by merely turning a knob control to either position. Underneath the console are located five units: one low-voltage supply and distribution amplifier, three power supplies, and the synchronizing generator. Each of these power supplies is connected by multi-conductor cable directly to the monitor unit above it, and to the low-voltage supply and distribution amplifier which distributes composite synch to each camera unit. The synch generator is coupled directly to the low-voltage supply and distribution amplifier unit.

Video Circuits

The output of the camera control monitor is fed directly to a built-in studio type video patch panel. All the video signals are controlled through the video patch panel which in turn feeds the signal to a picture distribution amplifier capable of providing up to eight video channels for line feeds. The output of the picture distribution amplifier is returned to eight points on the video patch panel and from there is distributed to microwave relay, line monitors, telephone line, etc. This signal is a standard 2-volt peak-to-peak. Over the video console is a 12 in. air/line monitor receiver, used to monitor either outgoing signal or to check on the signal from the station. A 'scope is also mounted on this panel and is used to monitor the video either from the various lines or the output of the picture relay transmitter. The director is located in this control room area and from his position can view all of the picture monitors. He is coupled to the camera control operators and the camera men by an intercom system and can direct camera angles or instruct the switcher over intercom hookup. Each position is also provided with a field telephone unit which in turn is connected to provide phone line to remote relay transmitter position or to the main studio or transmitter. The audio man is also connected into this circuit from his position as described in the previous article.

All of the equipment mounted on these consoles is equipped with shock mounts and quick-action releases so that they can easily be pulled out for servicing or for removal from the vehicle if it is necessary to operate outside of the Telecruiser. Spacing of the units on the consoles has been done with adequate provision for ventilation and accessibility for changing tubes without removing the units. This also provides more working space for the operators. Two large exhaust fans have been provided behind the console to exhaust the heat produced by the power supplies and other equipment. The shelf over the console acts as a collector hood to conduct this heat into the exhaust fans. Having operated in this unit in very hot weather in Texas and elsewhere, we find that these fans are essential and that we can maintain comfortable operating conditions even under extreme sun loading.

In the Telecruiser, the operators follow the modern trend of working blind, observing all action on the camera control monitors. No provision being made for viewing live action through large windows which have proved to be a hangover from audio operating days. It is essential for the video operator to concentrate on picture quality and the distraction of live action will take his attention off the television picture. All of the a.c. power distribution is controlled from the control room area by a circuit breaker panel and a Variac compensates for fluctuation in line voltage. A main a.c. power switch is located in the rear compartment with provision for selecting either the self-contained 5-kw gasoline driven generator or outside commercial service. This system can accommodate either single-phase 120-V, single-phase 120/240, or three-phase a.c. power. A 250-foot reel of four conductor #8 wire has been provided for connection to commercial power source that may be distant from the Telecruiser location. In the rear compartment, cable reels accommodate several assorted lengths of camera cable, microwave control cable, and a.c. power cable. All of these large cable reels are motor driven for ease of rewinding the cable. Other small cable reels are provided to accommodate microphone cable and video coaxial cable (RG59U).

The camera tripods are also located in this rear compartment along with four 250-watt flood lights for night operation. Other accessory equipment, adapter connectors, and various spare parts and tools are also included in this compartment. A removable door in the back of the video control console gives access from the storage compartment to the rear of the camera control units and provides an easy means of connecting and checking cables on this equipment.

Roof Platform

On the roof of the vehicle is a deck 20 ft. long and 6 ft. wide, covered with nonskid rubber material to provide safety for the operators. In addition a removable guard rail is also provided to keep the operators from accidentally backing off of the roof. Mountings to accommodate three cameras are attached to the deck and a clamping arrangement secures the camera tripod in place. With the cameras thus secured, it is possible to drive along while picking up a television picture. The microwave relay can also be secured to the roof and the picture relayed back from this vantage point. In order to relay the picture back to the tower however, it is essential to have an unobstructed line of sight air path between the microwave relay transmitter and the microwave relay receiver position. Sometimes it is necessary to place the microwave transmitter as far as 1000 ft. from the Telecruiser. In order to do this, the control unit is removed from the vehicle to a point closely associated with the transmitter unit and the video signal is fed to the control unit from the telecruiser by RG59U 72 ohm coaxial cable. This cable can be run as far as 2000 ft. when necessary.

In the WDTV Telecruiser (Pittsburgh) access to the roof is gained through a large hatch opening into the control room area. A ladder is provided on the control room wall so that the men can climb up onto the roof deck or pass equipment through the hatch. In the KBTV unit, the access to the roof is by a means of an exterior removable ladder.

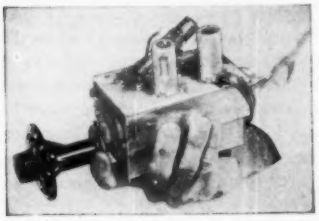
STL Relay Facilities

On the KBTV Telecruiser, using the

[*Continued on page V14*]

NEW PRODUCTS

● **Improved Inputuner.** Providing greater gain than any previous Du Mont Inputuner, the new series T3A is designed both mechanically and electrically for replacement of switch-type tuners in existing TV receivers. Standard mounting holes and identical space requirements make interchange of tuners a matter of minutes. Electrically the new Inputuner is designed to work into the i.f.



system of TV receivers using a separate sound i.f. Input impedance is 300 ohms. As in earlier models, the new T3A provides continuous tuning covering all TV channels as well as the FM band. It has low oscillator radiation and low noise figure. Cost is substantially lower than any previous Inputuner. Available at once to both jobbers and manufacturers from Electronic Parts Division, Allen B. Du Mont Laboratories, Inc., East Paterson, N. J.

● **TV Monitor.** Developed especially for TV station use, the new MTV-12 off-the-line monitor recently announced by Raytheon Manufacturing Company, Waltham, Mass. is ideal for viewing programs

in control rooms, film rooms, announcers' booths and executive offices. Picture tube size is 12½ in. An audio channel and speaker are included in the unit and may be used for either cueing or monitoring. Sturdy construction and light weight make the MTV-12 well suited for remote pickup use. Overall dimensions are 16 × 18 × 21 in.

● **TV Demonstration System.** As many as 100 TV receivers may be fed from a single antenna through use of the Taco master antenna distribution system, recently placed in production by Technical Appliance Corporation, Sherburne, N. Y. In operation the signal is fed through a power amplifier into a mixer and then into isolation boxes feeding one or two receivers each. Where no more than eight receivers are to be used the amplifier may be used alone without isolation circuits. In high-signal areas the amplifier is not

necessary, the signal being fed directly from the antenna into individual isolation boxes.

● **TV Deflector Yoke Core.** Designed for deflection of wide-angle picture tubes, the new Westinghouse deflector yoke core is made of Hipersil, a cold-rolled grain-

oriented electrical steel. The core is wound and bonded in circular form from a continuous strip of 5-mil material. The resultant thin laminations plus excellent magnetic characteristics tend to produce superior linearity and sharper pictures. The core is entirely free from magnetic instability due to temperature change. Complete data will be supplied by Westinghouse Electric Corporation, P.O. Box 2099, Pittsburgh 30, Penn.

NEW LITERATURE

● **Superior Electric Company,** Bristol, Conn. is now releasing a 16-page booklet fully describing the complete line of Powerstat variable voltage transformers. In addition to excellent illustrations, performance curves and wiring diagrams, the booklet contains a handy rating chart which provides engineers and purchasing agents with a quick selector index. When writing request Bulletin P550.

● **Allen B. Du Mont Laboratories,** Television Transmitter Division, 1000 Main Ave., Clifton, N. J. is now distributing an 18-page illustrated booklet on the Du Mont industrial color television system. Available to executives writing on business or professional stationery.

● **RCA Engineering Products,** Camden 2, N. J. has available for broadcasters an illustrated folder describing and illustrating RCA's latest field TV equipment, including an improved friction head, a new tripod, new field desk, and a rotatable mount and remote control for microwave parabola. Requests should be addressed to Department No. 522 at the address above, and should ask for booklet titled New TV Field Equipment.

● **Andrew Corporation,** 363 E. 75th St., Chicago 19, Ill. will mail Bulletin 39, fully describing the Andrew Type 738 ultra-low-loss coaxial transmission cable, free on request of prospective users. Type 738 is a semi-flexible ⅞-in. line suitable for connecting antennas to transmitters or receivers at frequencies from 25 mc to 2500 mc.

CBS TELEVISION INTERCOM FACILITIES

[*from page V7*]

time during rehearsal. Talkback microphones are also available to the video switcher and audio mixer permitting them to use this loudspeaker circuit to communicate with members of the technical staff who may be away from their stations and therefore not wearing their regular headsets or headphones. Interlocking relays, which disable this circuit when the audio console line key switch is thrown to the "air" position, are incorporated, thereby preventing accidental use of the talkback loudspeaker when the studio is on the air.

When compared to aural broadcasting studios, television studios are usually quite large; as a matter of fact, studios which a short time ago were considered large are now regarded as medium in size. The talkback speaker must be capable of producing quite high levels at the stage in use, as for example, when being used over the playing of a large orchestra. Rather than attempt to cover a large studio with a single high power talkback loudspeaker and driving amplifier, it has proven more practical to employ a small mobile loudspeaker unit which is moved to the area of the studio in use. This talkback loudspeaker is one component of the studio floor monitor described below.

The Studio Floor Monitor

The studio floor monitor, *Fig. 7*, is an indispensable unit of studio equipment. It is customary to provide at least two of these units in each studio. As can be seen, this unit combines, in a single cabinet, a picture monitor, a loudspeaker, and a clock. As described above, the loudspeaker is normally connected to the studio talkback circuit.

It is customary to place one or more of these floor monitor units at the stage in use in positions where they are visible to the greatest number of persons concerned with the production. Thus the performers, floor manager, and other studio personnel can see the production exactly as it is leaving the studio. Equally important, it is possible for them to follow the program continuity at

times when the action is originating on another set, on motion picture film, or from a remote point.

Smaller monitoring units containing only the picture monitor are provided for technical and production personnel who must closely follow the program continuity. Such units are installed at the sound-effects station, lighting panel, and in the announcer's booth.

Transcribed Audio Program Material

Portions of the audio material used in TV programs often originate on electrical transcriptions or magnetic tape. Quite often it is necessary for the performers in the studio to hear this recorded program material. One example where this would be necessary is in the case of a program wherein the inner thoughts of a performer are being made audible to the audience. This material is previously recorded and is played back at the appropriate time. It is essential, of course, that the performer in the studio hear this recorded material in order to properly coordinate his actions. Another example where recorded program material must be heard by the performers is in the case of music to which people in the studio are dancing. If this music is recorded, it is necessary that the dancers in the studio hear the music. Appropriate circuits must therefore be provided which will transmit recorded program material to a studio loudspeaker when desired, as well as to the regular outgoing audio program line. A block diagram of a suitable circuit arrangement intended for use with transcription turntables is given in *Fig.* 8. A similar arrangement will serve for magnetic tape reproducers.

The loudspeaker unit in one of the studio floor monitors may be employed to reproduce this recorded material in the studio.

Dressing Room Call System

Another branch of the TV studio intercom system which has proven extremely valuable in coordinating program production is a call system between the studio control room and the dressing rooms. This call circuit permits the director or his assistant to call each performer to the studio well in advance of his scheduled appearance.

The loudspeaker arrangement employed in the dressing room area will depend on the location and arrangement of the dressing rooms. Usually one or two loudspeakers placed in the dressing room corridor will be adequate. At other times, it may be necessary to install a small loudspeaker in each of the dressing rooms. In either event, the loudspeakers should be clearly audible at all points in the dressing room area. The associated circuits in the studio control room are shown in *Fig.* 6.

CONCLUSION

It can well be realized that a failure of the television studio intercom system during the production of a program would be just as devastating as a breakdown of the sound or picture facilities. For this reason, the design details of the intercom facilities should be worked out with the greatest forethought and care. For dependability, only the most reliable components should be employed. In addition, the circuits should be arranged to provide all possible emergency operating facilities including such features as a jackfield providing access to all important circuits and components and, as well, emergency sources of a-c, relay, plate, and filament power. If plug-in amplifiers are used in the audio system, the same amplifier types should be employed in the intercom system to permit complete interchangeability of amplifiers. As a matter of fact, the intercom facilities should be treated as an extension of the audio system and employ the same components and construction practices. The essential requirement is the ability to restore the intercom facilities to a normal operating condition in a minimum of time in the event of a failure of any portion of the system. If this is not possible, a failure of the intercom system may easily result in the complete disruption of an important program production.

Intercom facilities of the type described above have been in operation in the CBS-New York television studios for several years and have proven adequate to handle the requirements of the most elaborate programs originating from these studios. The basic design of these intercom facilities is not new but has evolved as a result of CBS' many years of experience in television studio operations. Ideas and suggestions which resulted in the design described have been contributed by many members of the CBS television staff. Many contributions were also made by Howard A. Chinn, CBS Chief Audio-Video Engineer, under whose direction the design and installation of the facilities were undertaken.

REMOTE TELEVISION BROADCASTING

[*from page V12*]

Du Mont 2000-mc relay, a permanently attached mast is provided to support the relay transmitter reflector, as shown in *Fig.* 1. This reflector is light weight with perforated metal reflecting surface, and the ribs are made of a fiber glass material. When not in use, the reflector dish is removed from the mast and stowed in the rear compartment. The mast itself can be folded back onto the roof. *Figure* 1 also shows the exterior features of the KBTV Telecruiser. At the roof level are waterproof outlets which provide a.c. to the flood lights or to service cords. Also provided is an outlet for the announcer's microphone. Looking through the open door, an operator can be seen seated at the video console and the audio man can be seen at the window just right of the open door. The exterior of the vehicle is attractively styled to serve as an advertising medium for the station.

Because of special operating conditions in various parts of the country and specific desires and needs of individual broadcasters there are no two Telecruisers built alike. Each one is custom built to incorporate the features deemed necessary. These features are established by close cooperation between the engineering staff of the station and the Du Mont Television Specialties Department, so that when the Telecruiser is delivered it is completely equipped and wired for audio, video, and a.c. having been thoroughly tested and checked out in all respects so that it will be operable immediately upon arrival at the station.

With a well trained crew of five men, it has been possible in many instances to leave the studio and proceed to a remote location having a picture for air broadcast in less than one hour's time after arrival at the pickup point. After the program has been completed, the Telecruiser can be ready to return to its base in a matter of approximately 30 minutes.

The two units described and shown in this article are now in active service in Pittsburgh and Dallas and have been used to pick up many hours of programming for their respective stations. They have proved through actual operation to be an indispensable piece of programming equipment, especially in those areas not presently connected with the various networks. Heretofore, stations in these areas have been dependent on film or recorded shows for the greater portion of their program material.

AUDIO SYSTEMS FOR TV SERVICE

[*from page V10*]

as part of the overall television installation.

Several of these systems have been installed and are daily feeding programs to the local stations and in some instances, to a network. Each has all the essential facilities required for a small studio installation, and its circuit flexibility has proven its worth on more than one occasion.

Video Engineering 1950

SUBJECT INDEX

AUTHOR INDEX

Wonderful way to feel!

You certainly can be on top of the world!

Why not? Your car is paid for and your house is halfway there. You're making pretty good money . . . the kids are healthy and happy . . . and your wife just bought a new outfit—shoes to chapeau!

You don't owe anybody a red cent. Not only that—you've got a little money salted away for the kids' education and your own retirement.

Wonderful way to feel, isn't it?

If this description doesn't fit you—*make it!* You can. Here's how:

Start saving right now! Just as much as you possibly can—*and regularly.*

One of the best ways . . . one of the safest, surest ways . . . is to buy U. S. Savings Bonds through the Automatic Payroll Savings Plan where you work. Or, arrange to purchase Bonds regularly at your post office or bank.

U. S. Savings Bonds will bring you, in ten years, $4 for every $3. And you can count on that!

Start your plan today. It's the very wisest way to save!

Automatic Saving is Sure Saving—
U.S. Savings Bonds

Contributed by this magazine in co-operation with the Magazine Publishers of America as a public service.

Rapid Attenuator Calculation Using the Vector Slide Rule

A. E. RICHMOND*

A time saving method of arriving at results which often require considerable figure-work.

RESISTIVE ATTENUATORS are used in a wide variety of audio circuits. They find application in audio level adjustment and in impedance matching, and are very widely used in such systems as recording, public address, and broadcasting.

Some attenuator design procedures have been used which are quite time-consuming and tedious. The procedure given in this article, using the "Vector" slide rule,[1] is comparatively rapid. With this method, attenuating pads having losses as great as about 26 db can be calculated quickly.

The very common "T" pad circuit of *Fig.* 1 will be used as the basis of this article. Based upon the method shown, the reader will doubtless be able to adapt the equations for other attenuator circuits to slide-rule computation.

Equations

The equations forming the basis of the procedure make use of hyperbolic functions, the hyperbolic sine *sinh* and the hyperbolic tangent *tanh*. At first glance, these formulas may seem to complicate the work beyond that required for some other procedures. However, as will be shown, only ten easy steps complete the side-rule solution of the entire attenator, and knowledge of the theory of the hyperbolic functions is not even necessary.

The hyperbolic functions are obtained by the use of scales *Sh1*, *Sh2*, and *Th*, which are illustrated in *Fig.* 2. This figure shows one side of the slide rule. These scales indicate the angles in radians whose hyperbolic sines and tangents, respectively, are given on scale *D*.

The equations used[2] as the foundation of the procedure are:

$$R_3 = \frac{\sqrt{Z_1 Z_2}}{\sinh \theta} \qquad (1)$$

*Consulting Engineer, Portland, Oregon.

[1] The article is based on the Log Log Duplex Vector slide rule No. N4083 of Keuffel & Esser Co. Illustrations used by permission.

[2] Equations (*1*), (*2*) and (*3*) are from "Reference Data for Radio Engineers," Federal Telephone & Radio Corp., New York, 3d Ed., pp. 158–9, by permission.

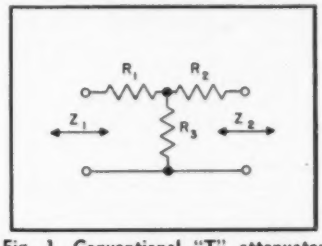


Fig. 1. Conventional "T" attenuator circuit, used as example in text.

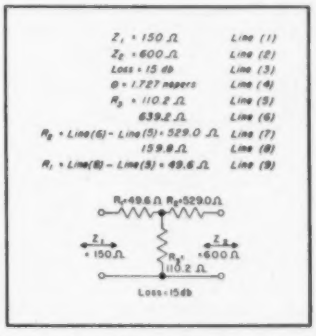


Fig. 3. Example of "paper" calculations. This figure shows the entire amount of paper work involved in designing attenuator to meet specifications of example in text. The remainder of the work is done directly on the slide rule. Bottom: the completed attenuator design required in the example.

$$R_2 = \frac{Z_2}{\tanh \theta} - R_3 \qquad (2)$$

$$R_1 = \frac{Z_1}{\tanh \theta} - R_3 \qquad (3)$$

where Z_1 and Z_2 are the input and output impedances between which the attenuator is matched, and either Z_1 or

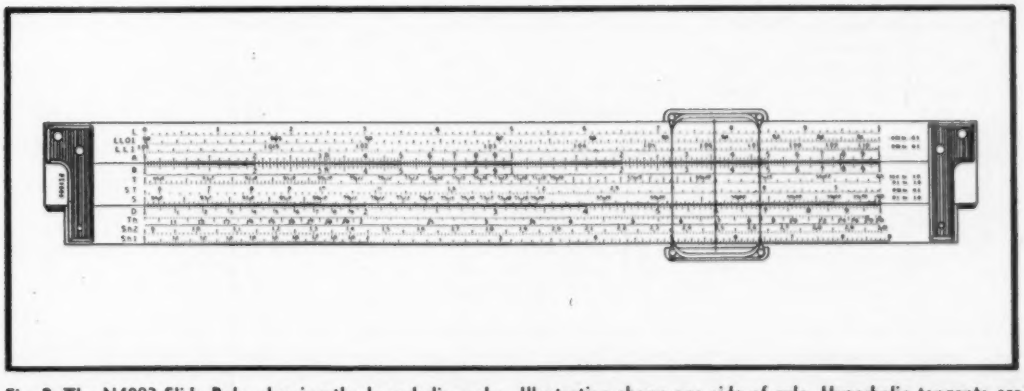


Fig. 2. The N4083 Slide Rule, showing the hyperbolic scales. Illustration shows one side of rule. Hyperbolic tangents are obtained by use of *Th* scale, while hyperbolic sines are given by use of scales *Sh1* and *Sh2*.

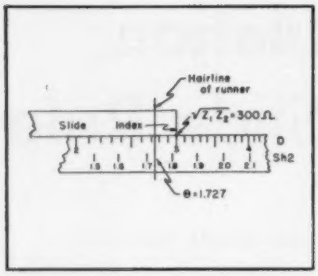


Fig. 4. Setting of θ on scale *Sh2* (corresponds to step 4 in text). (Copyright by Keuffel & Esser Co.)

Z_2 may be the source and the other the load; and

θ = the loss introduced by the attenuator in nepers

= the loss in decibels divided by 8.686

The simple procedure for the design of the "T" pad will now be given, including a detailed example. In this discussion, it is assumed that the slide-rule operator is skilled in the common manipulations of the rule, locating decimal points, etc. Illustrations are included for those slide-rule operations involving the hyperbolic scales.

Procedure

Assume that a pad is required to have a specified loss and is to operate between known input and ouput impedances. The problem is to find the values of R_3, R_2 and R_1 for the required "T" pad of *Fig.* 1.

(As an example, let Z_1 be the input impedance of 150 ohms, Z_2 the output impedance of 600 ohms, and the required loss 15 db. This information is entered as lines *1*, *2*, and *3* on a slip of paper, as shown in *Fig.* 3. This figure, incidentally, shows the entire amount of "paper" work required in the attenuator design, the remainder of the figuring being done on the slide rule.)

The first calculation is the determination of the value of R_3, which is a somewhat longer procedure than that for R_2 or R_1. Proceed as follows:

1. Convert the loss in decibels to loss in nepers, by dividing the number of decibels by 8.686. Use scales *C* and *D* in the usual manner. The loss in nepers is represented by the symbol θ.

(In our example, $\theta = 15/8.686 = 1.727$. This is entered as line *4* on the calculating sheet of *Fig.* 3. Some of the results, incidentally, will be given herein to a slightly greater accuracy than that obtainable with the 10-inch rule.)

2. (a) If the pad is to match unequal impedances, i.e., is unsymmetrical, multiply these impedances Z_1 and Z_2 together on scales *A* and *B*, and set the runner of the slide-rule to the square root of this product on scale *D*.

(In the example, $150 \times 600 = 90{,}000$, the square root of which is *300* on scale *D*. It is not necessary to record either the product or its square root, or even to observe the values.)

(b) If, on the other hand, the pad is symmetrical (matches equal impedances), simply set the runner to this impedance *Z* on scale *D*.

3. Set the index (the end of the scale) of the slide to the runner.

4. Set the runner to θ on scale *Sh1* or *Sh2*, and read the value of R_3 on the *CI* scale.

(In the given example, set $\theta = 1.727$ on scale *Sh2* as shown in *Fig.* 4. If the rule is now turned over, R_3 will be found as 110.2 ohms on scale *CI*. Enter the value of R_3 as line *5* on the calculation sheet.)

Next, we find the value of R_2.

5. Set the index of the slide to Z_2 on scale *D*.

(In the example being worked, Z_2 is 600 ohms.)

6. Set the runner to θ on scale *Th*, and record the reading at the runner on scale *CI* as line *6* on the calculation sheet.

(In the example, set $\theta = 1.727$ on scale *Th* as shown in *Fig.* 5. The rule is now turned over, and the corresponding reading on scale *CI*, 639.2 ohms, is recorded as line *6*.)

7. From the reading found in step 6, subtract R_3 as determined in step 4. The result is the value of R_2 for the desired pad.

(The value of R_2 for the attenuator in the example is 529.0 ohms, and is entered as line *7* on the calculating sheet.)

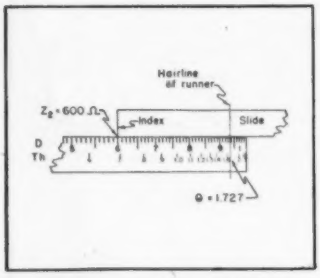


Fig. 5. Setting of θ on scale *Th* (corresponds to step 6 in text). (Copyright by Keuffel & Esser Co.)

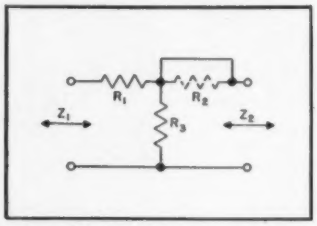


Fig. 6. The basic "T" attenuator circuit. Conversion to minimum-loss L-pad is made by eliminating R_2; values of R_1 and R_3 are determined in accordance with text.

The procedure for obtaining R_1 is similar to that for R_2, and does not require additional diagrams, for its explanation.

8. Set the index to Z_1 on scale *D*.

(For our example, Z_1 is 150 ohms.)

9. Set the runner to θ on scale *Th*, just as in step 6. Record the reading of scale *CI* at the runner.

(In the example, this is 159.8 ohms, and is entered as line *8* in *Fig.* 3.)

10. From the reading found in step 9, subtract R_3 as determined in step 4. The remainder is the value of R_1 for the required pad.

(In the example, R_1 is 49.6 ohms. The completed attenuator design is shown at the bottom of *Fig.* 3.)

For the convenience of those who do not have ready access to tables of hyperbolic functions, the decimal points of the *sinh* and *tanh* values can be located as follows:

The value of *sinh* θ is roughly equal to θ for values of θ from 0 to 0.5. *Sinh* $\theta = 1$ when θ is roughly 0.89, and *sinh* θ becomes 10.02 when $\theta = 3.0$.

The value of *tanh* θ is roughly equal to θ for values of θ from 0 to 0.4. *Tanh*

[*Continued on page 46*]

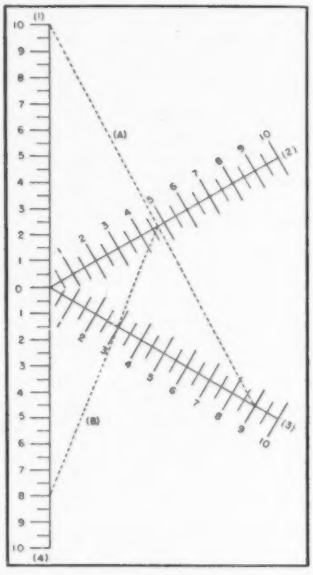


Fig. 7. Graphical solution for resistors in parallel; a handy device for attenuator design and general audio work. (From "Motion Picture Sound Engineering," D. Van Nostrand Co., Inc., New York, N. Y., by permission)

Determining Unknown Impedances in Transformers

LOUIS H. HIPPE*

A simple method for obtaining information about the characteristics of unknown transformers.

IN MANY AUDIO INSTALLATIONS the technician is sometimes faced with the problem of determining quickly and with reasonable accuracy the unknown impedances of transformer windings. At other times the technician may find himself with a transformer that could be put to good use, but unfortunately he is unable to obtain sufficient data on the impedance capabilities of the transformer to make it usable in a practical application. At other times he may find that he has available several of the 400-cps power transformers of the type used in surplus military equipment. These transformers can often be used in audio installations where the power requirements are not too great—depending, of course, upon the internal insulation of the power transformer but "spec" sheets on winding impedances for audio service are not available for this type of transformer.

Once the impedances of primary and secondary windings of *any transformer* are known the transformer then becomes valuable and usable as a component in construction of new equipment or replacement in equipment already in use. However, unless the technician experiments by cut-and-try, he is not apt to know, even in a general sense, just what tubes or other components the transformer will allow him to match. Since cut-and-try requires a lot of time, and since there is no logical place to start, the transformer is likely to be relegated to the junk box where it will kick around until it eventually finds its way to the ash can. Good equipment can be saved from such a fate with a little effort and a minimum of equipment.

Calculation Methods

There are several possible transformer impedance calculation methods and techniques available which will give results of reasonable accuracy. Although not of the caliber of laboratory measurements, the tolerances are accurate enough for average service.

Most audio technicians own or can borrow a volt-ohm-milliammeter (preferably of the vacuum tube type); a 1,000-cps audio oscillator can be built easily. With these two pieces of equipment, plus a few odds and ends, the unknown impedances of any transformer winding or choke can be quickly computed.

Figure 1 is the schematic of a 1,000-cps audio oscillator which will prove a valuable asset to the workshop and laboratory in addition to the specific use about to be described. It is inexpensive to build since parts are held to a minimum and may be selected from spare part components.

In making impedance calculations, it is well to remember that one of its constituents is reactance. Reactance of a given coil or transformer winding changes with the frequency applied. Because reactance changes with frequency, it follows that impedance also changes.

We are therefore interested in an oscillator as a source of voltage at 400 to 1,000 cps because it allows us to obtain a greater degree of accuracy in making impedance checks on a transformer that will eventually be used in the voice-frequency range. A 60-cps test voltage source is somewhat less accurate especially if the transformer has poor response at 60 cps.

With the meter and test oscillator we can conduct our impedance determining experiment on the assumption that *voltage ratio is proportional to the turns ratio and that the impedance of a winding varies as the square of the turns.* This is expressed by the formula:

$$\frac{Z_g}{Z_t} = \left(\frac{V_g}{V_t}\right)^2 \qquad (1)$$

Where Z_g is the known primary impedance.
Z_t is the unknown impedance.
V_g is the known applied voltage, and
V_t is the voltage measured across the unknown winding.

Note the statement, "where Z_g is the *known* primary impedance." This value

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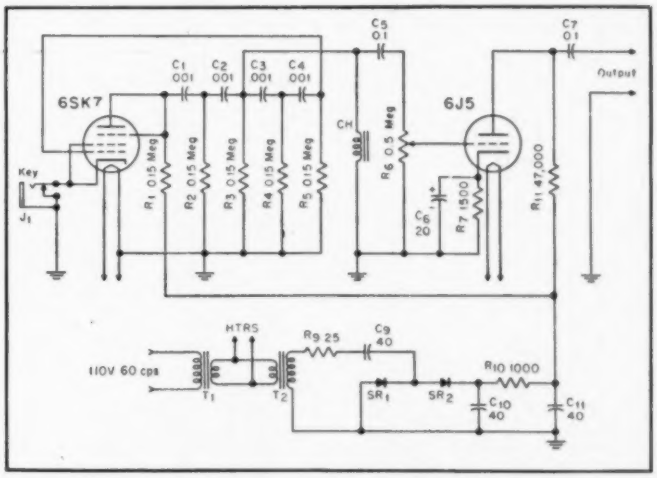

Fig. 1. Simple 1000-cps oscillator which can be constructed readily and which is useful in making measurements of the type described in this article. CH is small a.c.-d.c. filter choke; SR_1 and SR_2 are 60-ma selenium rectifiers; T_1 and T_2 are 6.3-volt, 1.5 amp filament transformers "back to back."

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AUDIO DESIGN NOTES

Resonant Loudspeaker Enclosures

BOB H. SMITH*

THIS CHART is based upon the assumptions that the dimensions of the enclosure are small compared to wavelength, that the thickness of the port is negligible, and that the amount of air moving in the port is equal to the three halves power of the area of the port. Thus, the inertance of the port is:

$$M = \frac{\rho}{\sqrt{A}}$$

where A is the area of the port and ρ is the density of air. The compliance of the enclosure is:

$$C_a = \frac{V}{\rho c^2}$$

where V is the volume and c is the velocity of sound. The resonant frequency of a Helmholtz resonator is:

$$f_r = \frac{1}{2\pi\sqrt{MC_a}} = \frac{c}{2\pi}\frac{A^{\frac{1}{2}}}{V^{\frac{1}{3}}}$$

This expression seems to agree well with experiment. In a typical case the error is 5 per cent.

It is customary to choose the resonant frequency of the enclosure equal to the anti-resonant frequency of the moving system of the speaker. Since the impedance of the resonator is purely resistive at resonance and represents a very heavy load, no oscillatory transient occurs at this frequency. However, a new transient of higher frequency appears. It is caused by the mass of the moving system going into anti-resonance with the compliance of the box. Thus, the resonant enclosure does not completely eliminate the production of oscillatory transients but usually the new transient will be of shorter duration than the one which would have occurred without a resonant enclosure.

The radiation resistance is proportional to the area of the port and is usually too low for efficient energy transfer. Thus, the

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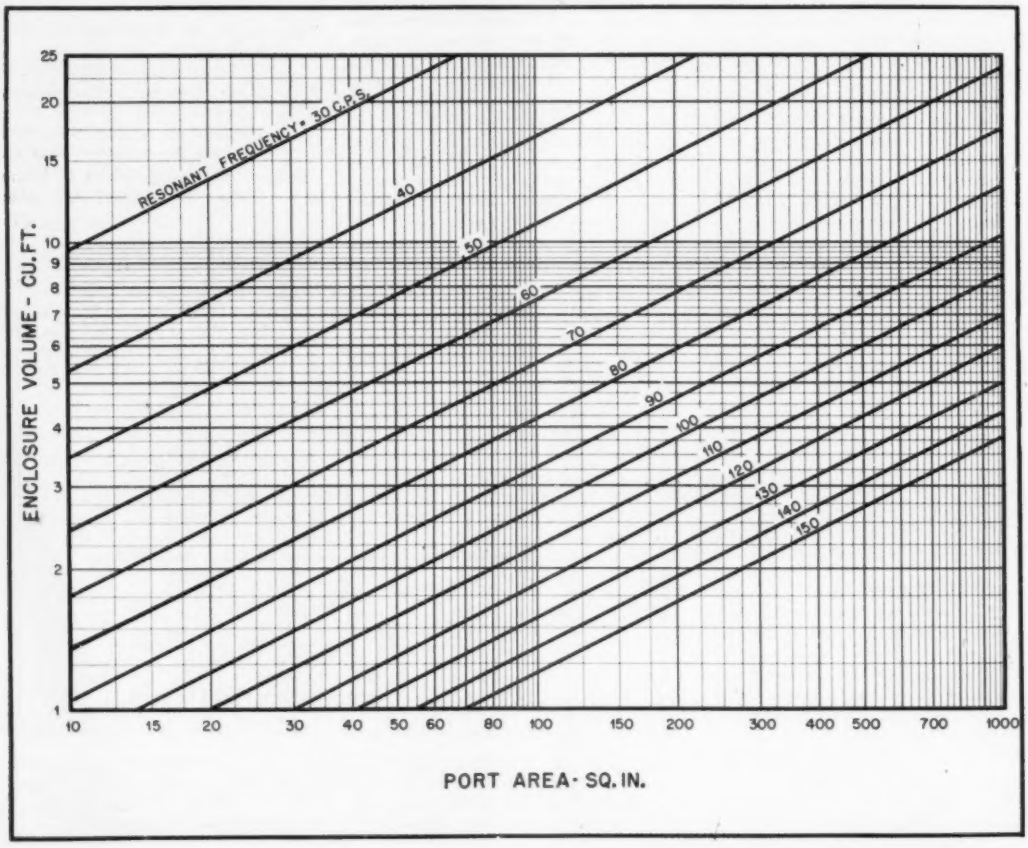
* *Division of Engineering, University of California.*



AUDIO engineering society

Containing the Activities and Papers of the Society, and published monthly as a part of AUDIO ENGINEERING Magazine

Audio Engineering Society, Box F, Oceanside, N. Y.

Convention Report

THE SECOND ANNUAL CONVENTION of the Audio Engineering Society fulfilled the hopes of the Society members and officers and, along with the Audio Fair, attracted a large number of visitors from the New York area as well as many hundreds from out of town. The five technical sessions were well attended, and some of the papers will appear in these pages in future issues.

At the Business Meeting, held on Thursday morning as the first session of the convention, witnessed the installation of the officers for the coming year. Theodore Lindenberg, retiring president, announced the results of the election, and after a brief farewell message relinquished the chairmanship of the meeting to John D. Colvin, newly elected president. The others taking office at this time were: C. G. McProud, executive vice president; Bob Hugh Smith, Western vice president; Lawrence Shipley, central vice president; Norman C. Pickering, secretary; and Ralph A. Schlegel, treasurer. The latter two were continued in the offices they held for the past year. Howard A. Chinn, H. E. Roys, and Theodore Lindenberg were elected to two-year terms as governors.

The annual honors were presented at the Banquet, held on Thursday evening, October 26. The Society's own award was presented to C. A. Rackey in recognition of his continued work in furthering the progress of the Society since it was founded. Howard A. Chinn received the John H. Potts Memorial Award "for outstanding achievement in the field of audio engineering," a plastic-embedded silver medal awarded annually to a person chosed by the Society. Presentations were made by C. J. LeBel, acting on behalf of W. L. Black, chairman of the Awards Committee, who was unable to be present.

Following the banquet and the presentation of the honors, the diners were entertained by a musical group composed of Johnny Johnson and Harry Lennon with accordion and bass, and by Lee Irwin and The Mariners, from the Arthur Godfrey programs.

SAN FRANCISCO SECTION ELECTS

The San Francisco chapter of the Audio Engineering Society announces the results of an election held recently for officers of the section for the 1950–51 term. The results were as follows: chairman, Dr. Vincent Salmon, Stanford Research Institute; vice-chairman, Harold Lindsay, Amplex Electric Corporation; secretary, Frank Haylock; treasurer, Myron J. Stolaroff, Ampex Electric Corporation; executive board members, Walter T. Selsted, Jack Hawkins, and Ross Snyder.

T. M. McCarty

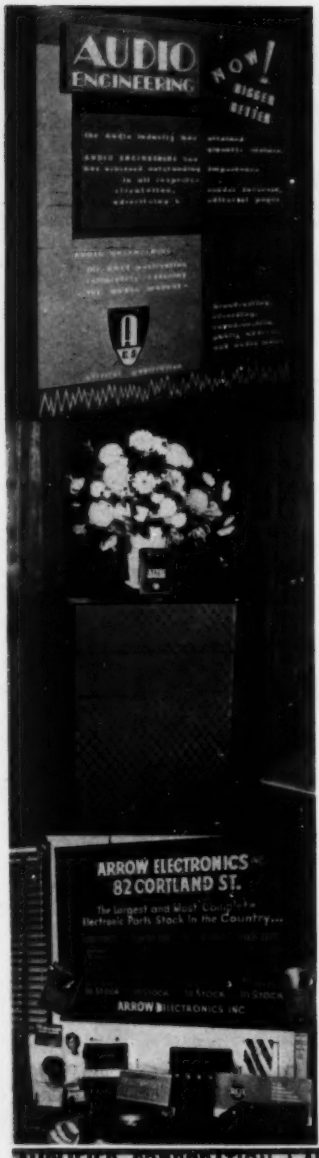
SOUTHERN MICHIGAN SECTION ELECTS NEW OFFICERS

The Southern Michigan Section of the AES announces the following results of the annual election: Chairman, T. M. McCarty, president, Gibson, Inc., Kalamazoo, Mich.; Vice-chairman, Earl S. Stone, chief engineer WELL, Battle Creek, Mich.; Secretary-Treasurer, Walter Fuller, chief electronics engineer, Gibson, Inc.; director (two-year term), Wade Allen, Allen Electric Co., Kalamazoo, Mich.; director (one-

[*Continued on page 59*]

Left, C. A. Rackey (left) receiving Society's Award from C. J. LeBel. Center, John D. Colvin, new president, welcomes visitors to the Convention and the Audio Fair. Right, Howard A. Chinn receives the John H. Potts Memorial Award from Mr. LeBel.

The Audio Fair Review



THE SECOND AUDIO FAIR has come and gone—with appreciably more success than its forerunner, the First Audio Fair. Again, for three days, the halls of the fifth and sixth floors of the Hotel New Yorker were more than filled with a milling throng interested in audio to the extent that they were willing to spend long hours on their aching feet to hear the newest in speakers, amplifiers, pickups, and recorders. And the new items were there *en masse*, along with the time-tested-and-tried devices that are always interesting to the enthusiast when demonstrated under what are the best conditions possible, in the opinion of the manufacturers, for their particular equipment. Actually, from the listeners viewpoint, it is doubtful if this is an ideal condition, because of the background of noise from the many exhibition rooms. However, there is no doubt about the over-all value of this type of exhibit, because—even though the conditions are not perfect—the visitors do get an impression of the quality of performance of the many items, and the interest awakened by it is sufficient to warrant further investigation under more intimate conditions.

For the professional engineer, the exhibits of tape recorders were of great interest, with many types being displayed for the first time. Microphones suitable for all purposes were seen, speakers of the highest quality for monitoring purposes, and all types of recording machines, tape, and discs. One complete display of a broadcast console attracted the broadcast engineers almost as much as the tape recorders—of which there were many more than one.

On the whole the Second Audio Fair was a much greater success than the first, with a fifty per cent increase in exhibitors and in registration—the preliminary figures for the attendance indicate that approximately 4700 visitors were present over the three-day exhibit, with many of them being on hand two or even three days.

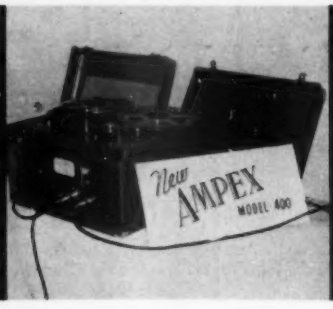
The photographs of the various exhibit rooms will give to those unable to attend an idea of the highlights of the Fair—every exhibitor has something interesting to show, and each one of them spent a long and arduous three days of explaining and demonstrating, so that all felt a sense of relief each day when the a.c. power was cut off signifying the end of the exhibit hours. Without this drastic means of signalling the closing hour, it is doubtful if the visitors would have left at all—especially on Friday evening, the only time many were able to attend. The following paragraphs will cover the exhibits in detail, with each exhibitor's display being described briefly.

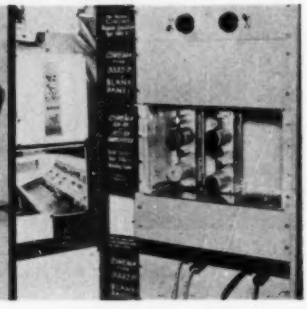
Altec Lansing Corporation exhibited a new corner cabinet housing two 15-inch driver units and a multicellular horn, along with the other more familiar members of its line—the 800, the 604B, the 603, the 600, and the 8-inch model 800. The new unit, with the advantage of two low-frequency drivers, showed excellent response characteristics, and an extremely large power handling ability. The interest in this entire exhibit was so great that it was usually difficult to get into the room, but nearly everybody did at one time or another, and the demonstration of the strength of the field magnet used in one of the larger speakers was convincing—even to anyone who did not understand what it all meant to the performance of the speaker. The always-present-but-little-seen condenser microphone was also on hand for display, while others were in continual service for sound reinforcement during the technical sessions and the banquet.

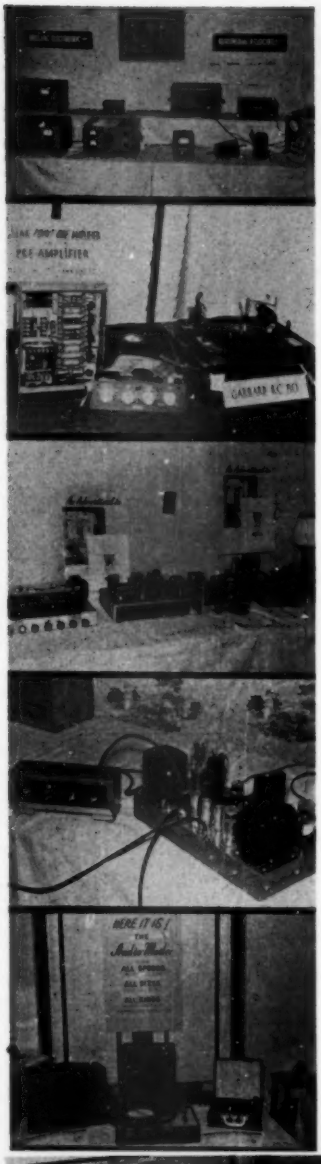
Ampex Electric Corporation's new Model 400 Tape Recorder—of which much has been heard during the past few months—proved that it lived up to its specifications as to quality. The demonstration consisted of playing a tape on the big Ampex, re-recording it on the 400, and reproducing the output of the playback head of the smaller machine on an A–B test with the signal being recorded. This was a truly convincing method of demonstrating the quality of a new product in comparison to that of the already well established performance of the leader of the line. After hearing this demonstration, the listener had no doubts of the ability of the small machine to perform completely in accordance with its specifications, which are sufficiently stringent for practically any professional application.

Amplifier Corporation of America presented a 24-hour, 3¾-in. per second recorder with quality considerably better than most 7½-inch machines of a year ago. The improvements in slow-speed tape

From the top, reading counterclockwise: Audio Engineering, Altec Lansing Corp., Arrow Electronics, Inc., Amplifier Corporation of America, Ampex Electric Corp., Cinema Engineering Co.







recorders has been truly remarkable in the last twelve months, and for applications requiring a high quality source of sound for long periods, a machine of the type exhibited here would certainly serve the purpose admirably. With such an installation, hotels and restaurants could be freed from the need for wired services, and would be able to schedule the kind of music or entertainment that was most suitable for the hour or location. In addition to the long-playing machine, a large number of other types of recorders were on display, of sufficiently wide variation of cabinet, styling, and facilities to fill the needs of most semi-professional users.

Arrow Electronics, Inc., a New York City jobber, kept its display room full of visitors during most of the show hours, and well it might, because of the wide variety of components for high-quality music systems that were on display. The jobbers had somewhat of an advantage over some manufacturers because they have available all types of equipment, and are therefore able to make comparisons right on the spot. Tuners, turntables, amplifiers, even television parts, all were on display here.

Audak Company, preferring to demonstrate for quality of sound rather than quantity, conducted its displays of performance behind closed doors. To many visitors, this was a welcome change from the somewhat overpowering sound which filled the corridors of the fifth and sixth floors of the hotel. Using a choice of two recognized amplifiers and a high-quality two-way speaker system, the performance of the Audax Polyphase pickup was shown at normal living room levels, and with the finest of taste in selection of program material. Available now with special adapters to fit the Webster and Garrard changers, the Audax Polyphase —with two styli and therefore capable of reproducing all types of home records without changing arms or heads—is rapidly gaining favor, both for its quality and for its convenience in use.

Audio Devices, Inc. had only two items to exhibit—but each of these was available in so many varieties that their display was still quite elaborate. First, the famous Audiodiscs were there in full force, in many diameters and in all grades from the perfection required for masters to the smaller and lighter-base types used by the amateur. Second, the variety of magnetic tapes on display was so great as to surprise those who have previously known only of the standard ¼-in. plastic or paper tape used on conventional tape recorders. Types shown included plastic-base tape from ¼ to 2 inches wide, several widths of paper-base tape, 16-mm film with single and double perforations, 17.5-mm film with single perforations, and 35-mm film with double perforations. All it takes to bring out a special tape is to show a need for it, and anything imaginable can be made.

Audio Instrument Company showed a new device intended to generate a signal, composed of both low and high frequencies, which could be used with any oscilloscope to give a qualitative measurement of intermodulation distortion, as well as with the Bridger—an instrument designed to permit the measurement of small audio voltages without appreciable loading of the source. This instrument has fulfilled the need for an a.f. coupling unit of extremely high impedance, a necessity in development and laboratory work, and a useful accessory in the service and experimenter's shop. The Intermodulation Set offers in compact form a source of signal for IM measurements which is entirely suitable for most developmental work.

The Audio Master Company displayed a number of portable record and transcription players which fill the need for a small unit suitable for the salesman who has a product which is best demonstrated by the use of records, or by a salesman for the records or transcriptions themselves. These units are also well adapted for p.a. system use, as well as for schools and other educational applications.

Bell Sound Systems Inc. displayed for the first time a new amplifier of exceptional merit, Model 2145. This all-triode unit with an output in excess of 15 watts combines a number of useful features, principal of which is the use of a remote control unit which is connected to the main chassis by a single cable. All inputs are plugged directly into the amplifier chassis, and by the use of cathode followers the signal can be fed to the control unit by a cable as long as 25 feet without frequency discrimination. The high-gain input employs a two-stage preamplifier on the main chassis, thus isolating the low-level signals from the cable. The selector switch on the remote control assembly makes a choice between phono and radio signals, compensates for record characteristics, and adjusts high-frequency roll-off. Bass and treble tone controls and a compensated volume con-

From the top, reading counterclockwise: Burlingame Associates, British Industries Corp., Browning Laboratories, Inc., Bell Sound Systems, Inc., The Audio Master Co., Audak Company, Inc., Audio Instrument Co., Audio Devices, Inc.

trol complete the remote unit complement, with the signal being fed back through the cable from the output of another cathode follower in the remote box. In all, this unit appears to have had much thought in its design, and was apparently planned with the needs of the user well in mind.

British Industries Corporation had a number of imported items on display, including the Garrard RC80 record changer, the Leak "Point One" amplifier, and the complete line of Wharfedale speakers. Both the changer and the amplifier are well known in this country by this itme, but the Wharfedale line is relatively new. This group of speakers, ranging from an 8-inch model up to a 15-inch heavy-duty job, provide a full range of types for all applications where quality is a requisite. Most of the models are built with cloth surrounds, resulting in lowered resonant frequencies, and giving an extremely flexible cone mounting. The Point One amplifier, of a type similar to the "Williamson" now so famous in this country, derives its name from the distortion at rated output, 0.1 per cent.

Browning Laboratories had on display its entire line of tuners, just recently improved with the addition of automatic frequency control. Two models of the AM-FM receivers were shown, one with a power supply on the same chassis and with complete tone control facilities, and another consisting solely of a tuner for both bands and designed for systems where the control of tone and volume is incorporated in a separate amplifier unit. The smaller FM-only chassis is primarily intended for use where a suitable AM chassis is already available, or for those critical listeners who do not want anything but FM. This unit has its own power supply, but does not have the tone controls. All models have exceptional sensitivity on the FM band, and the quality is above normal on either type of receiver.

Burlingame Associates and **Brujac Electronic Corporation** exhibited a number of unusual items, among them being a Danish importation in the form of an elaborate oscilloscope. The entire standard line of Hewlett-Packard products was shown, with prominence being given to the newer types of combined gain sets and oscillators. Laboratory power supplies, high-gain a.f. voltmeters, and the versatile Tektronix oscilloscope filled out the line of equipment shown.

Cinema Engineering Company had a number of useful and practical items of particular interest to the professional, although the advanced experimenter is also likely to find many uses for the convenient chassis available from this company. In addition to these shock-mounted, quick change chassis, a wide line of attenuators, filters and equalizers was shown, all designed with the needs of the particular application uppermost in the requirements for the product.

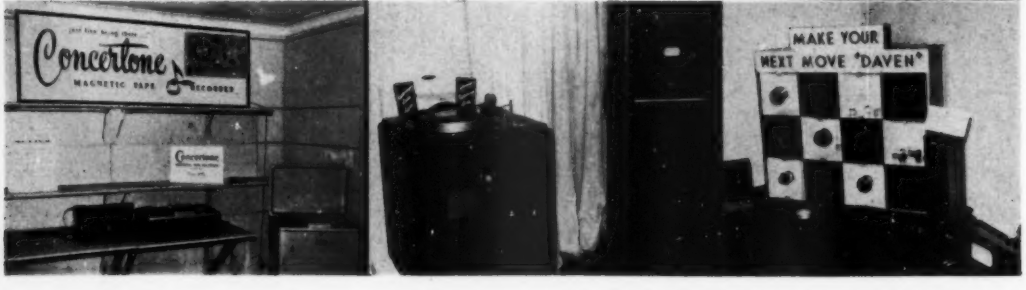
The Daven Company, long established as one of the "standard" manufacturers, exhibited its newer line of instruments, topped off by the distortion and noise measuring set described in these pages last month. The Daven line of laboratory instruments is expanding gradually, and each new addition lives up to the reputation of the builder and further enhances it. The 11-A Gain Set, announced last year, is now a familiar item, and many of them are in continuous service. It is expected that the new distortion measuring instrument will soon achieve wide use among those who require high precision in measurements.

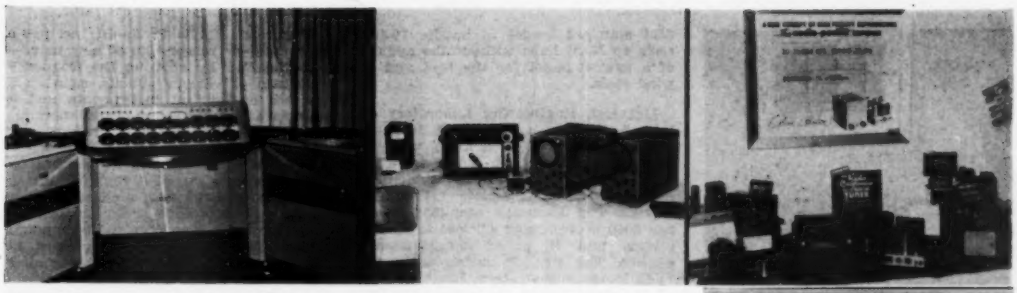
Electronic Workshop exhibited a variety of equipment ranging from a cleverly designed miniature audio oscillator to complete custom equipment for the home. Their own design of amplifier was presented in a highly polished chrome plated model for the Fair or for those who enjoy having equipment which may be shown off as a prized possession. With a preamplifier having the same knob spacing as the Browning tuners usually employed by **EW** in their custom work, the resulting appearance of the installation is well above average.

Electronics of Staten Island, a newcomer to the audio field this year, had two new corner speaker cabinets on display, one containing the speaker alone and another with a built-in tuner, amplifier, and record changer. The performnace from these cabinets was above average, indicating the advantage of using the room corner as an element of the speaker housing by reducing the solid angle into which the speaker must radiate. Cabinetry and finish on both models displayed were of excellent appearance, and because of their relatively small size these units would make welcome additions to most living rooms.

Electro-Voice, Inc. displayed its entire line of microphones, pickup cartridges, and speakers, the latter including mechanisms only as well as a number of furniture cabinets. Outstanding among the line is the Patrician, a massive corner cabinet constructed under license from Klipsch, and incorporating a low-fre-

From the top, reading clockwise: Electronic Workshop, Electronics of Staten Island, Electro-Voice, Inc., The Daven Company, Fairchild Recording Equipment Corp., Fisher Radio Sales Co., Inc.





From the top, reading clockwise: Gates Radio Company, Gawler-Knoop Co., Hudson Radio & Television Corp., General Electric Co., Harvey Radio Co., Inc., Harrison Radio Corp.

quency horn folded into the corner, two direct-radiating cones, and two multicellular horns, the smaller covering the range from around 3500 cps as far as the signal source required.

Fairchild Recording Equipment Corporation exhibited a complete line of high-quality disc recording apparatus, together with a rack of equipment designed for the better quality transcription studio where off-the-air recordings are made as a regular business. Outstanding interest was shown in an equalizer which featured continuously variable peak frequencies at both low and high ends of the spectrum, and with continuously variable amounts of equalization at the frequencies selected.

Fisher Radio Corporation showed their line of high-quality radio receivers and amplifiers along with the new Concertone tape recorder, which is the most compact model yet shown which will handle the standard 10-inch reels on NAB hubs. Incorporating a three-motor chassis of cast aluminum, with the amplifiers mounted directly on the unit, the entire recorder can readily be carried in a single case. This model is made with two speeds—7½ and 15 inches per second—and with either single or double track heads, either type of which is readily changed for the other in a matter of minutes.

Gates Radio Company had on display a complete console for broadcast station use, along with several types of amplifiers and remote input equipments. One model of remote amplifier, designed for use with either a.c. or batteries, is equipped with an automatic changeover feature which connects the battery supply immediately in case of failure of the power source. The station console, with two turntables, is so arranged as to provide for comfortable operation and has facilities for two separate programs, or for one program and one audition channel. Neatness of design and construction features the entire Gates line, and accessibility for maintenance is one of the strong features of the equipment.

Gawler-Knoop Company, manufacturers' representatives, showed the lines of Allen B. DuMont Laboratories, Ballentine Laboratories, and Clough Brengle Co., with cathode ray oscilloscopes with attached Polaroid Land camera for permanently recording the traces under observation, a product of the DuMont organization. From Ballentine, the new models of electronic voltmeters—always so popular in the field—were shown, together with a number of accessories which extend their usefulness. The Clough Brengle Audiomatic sweep generator, which provides a frequency swept signal over the entire audio range or over any selected part of it, was also a hit with the visitors who are engaged in any sort of development work.

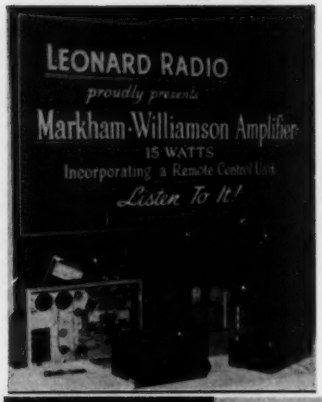
General Electric Company exhibited two of its major products in the audio line—pickups and loudspeakers. A mammoth phonograph cartridge employing the quick-change stylus assembly was an attractive feature, since it showed the method by which the styli were changed for standard or LP records, and in a form large enough for everyone to see the actual working of the device. The display of a S-1201 speaker actuated by a 60-cps a.c. source and illuminated by means of a Strobotac gave convincing demonstration of the operation of the speaker cone under high-level excitation. A moving cutaway of one of the same speakers served to show the features of the internal construction, with the magnet, polepieces, voice coil and support being plainly visible when the unit split apart.

Harrison Radio Corporation featured the Electronic Workshop A-18 amplifier, shown for the first time at the Fair. In addition, the current most popular lines of equipment — including turntables, phonograph pickups, speakers, and radio tuners, were all there in abundance. Harrison also had a novelty item as a giveaway which was the source of fun for the visitors all through the Fair days.

Harvey Radio Company, Inc., featured the Magnecorder in its various forms, together with the Lansing corner speaker, Rek-O-Kut turntables, and the Audak Polyphase pick-up, and with this assembly of components which are now familiar to the music lover and audio hobbyist alike produced a quality of sound which was only to be expected from such distinguished equipment.

Hudson Radio & Television Corporation, another New York City jobber, exhibited a wide variety of components for sound systems, ranging from the Audio Pacific, Bell, Electronic Workshop, and H. H. Scott amplifiers through Radio Craftsmen AM/FM tuners, a selection of speakers, and the Masco tape recorder. The Audio-Pacific amplifier, exclusive at Hudson, was shown to have exceptionally flat frequency response and low distortion throughout the entire range.

Langevin Manufacturing Corporation, showed a full line of quality transformers along with a number of professional type plug-in amplifiers and two power amplifiers designed for home or professional use. One of these latter units, encased in a convenient wall mounting cabinet, and of excellent quality, is

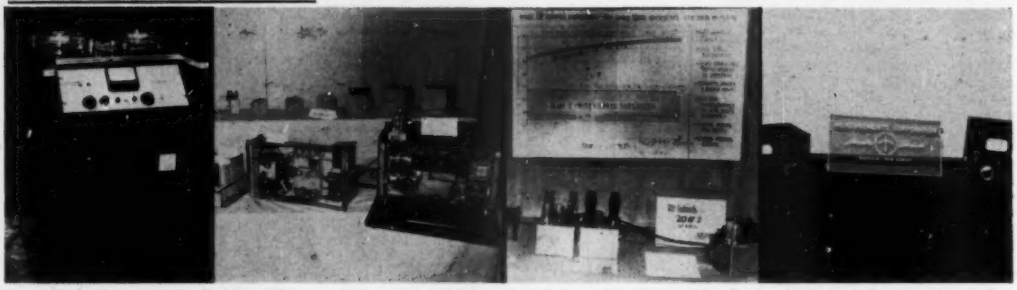


first standard model to handle 10-inch reels on NAB hubs without the addition of a special panel for the feed and rewind reels.

McIntosh Engineering Laboratory exhibited its two amplifier models, the 50-W-2 and the 20-W-2, along with the new preamplifier AE-2 which incorporated the input stages and controls necessary for a complete reproducing system. The McIntosh amplifier circuit has been proven more efficient than most others, and it is of unquestionable quality. The smaller model, using two 6V6's in the output stage, has an output of 20 watts, which is remarkable for 6V6's. The unit is compact, being housed in a single chassis unit of unconventional design. The 50-W-2 model, using 6L6's, consists of two similar chassis, the power supply being separate from the amplifier. These models are extremely flexible,

Panoramic Radio Products, Inc. put a new note—or rather lots of new notes—into the Fair by showing the frequency structure of various signals, such as a number of musical instruments and a number of human voices. The Panoramic sound analyzer continually sweeps over the audio spectrum and indicates the amplitude of all frequencies present on the screen of a c-r tube, thus permitting the user to observe the characteristics of the signal present or in the case of amplifier testing, to observe the amount and character of distortion present in the output signal. A number of similar instruments for a wide variety of different purposes were also on display, but the analyzer attracted the most attention.

Peerless Electrical Products Division of Altec Lansing Corporation had a large number of interesting items on display. The now-famous Musicians amplifier, described in Æ in November 1949, leads



Upper left, Leonard Radio, Inc. Center, left to right, Magnecord, Inc., Langevin Mfg. Corp., McIntosh Engineering Laboratory, Measurements Corp.

especially suitable for use in wired music systems or for p.a. use in such places as restaurants, dance halls, skating rinks, and other such locations where the highest quality and reliability are requisite.

James B. Lansing Sound, Inc. had on display one of their largest speaker systems for home use, although from its quality and output power it would definitely be suitable for monitoring in professional applications. This model, the D-1005, incorporates two woofers and an eight-cell horn with a crossover in the vicinity of 1000 cps. It was finished in a light blond hardwood, and presented a very attractive appearance. The entire line of speaker mechanisms was also shown, ranging from the 8-inch model up to the heavy-duty 15-inch woofers.

Leonard Radio, Inc., with a complete line of radio tuners, amplifiers, speakers, turntables, and even a TV console suitable as an entertainment center for the home, featured the Markham-Williamson amplifier, a new 15-watt unit with a remote control unit permitting adjustment of tones and volume to the user's satisfaction without the need for him to leave his favorite easy chair. This amplifier is built along the lines of the entire Williamson circuit—from low-level input to output stages—and is sure to be another contender for amplifier honors.

Magnecord, Inc. had several models of its recorders available and all on demonstration, ranging from the portable PT63J through its various forms up to the new console PT7-AX in a cabinet which contains all the amplifiers necessary with the machine. This model has attracted considerable attention, largely because of its mechanical features and the convenience of operation. It is the

and are readily adaptable to a wide variety of requirements.

Measurements Corporation displayed its line of precise laboratory instruments, with the intermodulation meters—two of them and both new—taking the spotlight. These instruments, which were described in last month's issue, incorporate several new and useful features, and serve to round out the line of measuring instruments designed for the laboratory or for the advanced experimenter—if his needs warrant the most accurate instrumentation.

Midway Radio and Television Corporation, another New York jobber recently to enter the field, displayed the Radio Craftsmen tuner, and offered to visitors a stroboscope disc useful in checking accuracy and constancy of turntable speed. Midway also featured the Rauland 1825 amplifier with its unique preamplifier which can be mounted in a number of methods so that the user can select the mounting which best fits his requirements. When a relatively small space is available for the controls of the amplifier, the Rauland is especially attractive.

Milo Radio & Electronics Corporation offered as its most interesting exhibit a display of the new ModulaR amplifiers and components which incorporate a new style of construction which permits the joining of several units or component assemblies together to make a single, solid chassis. Thus a power supply can be placed on a chassis along side the power amplifier, and other parts or sections of amplifier can be added as required or as the need for them develops. The Garrard changer was also featured by Milo, along with the new Audax head mounting for this changer.

the line for popularity, and it is now followed by the Musicians Amplifier, Senior, which is a theatre-type 50-watt unit employing 845's. This unit is intended to be driven by the original Musicians unit. Also shown was a new amplifier using the space-charge-grid tubes which have finally reached the market. This model will be described shortly in these pages, and will undoubtedly follow the Musicians amplifier into the Hall of Fame for good audio equipment.

The Permoflux Corporation proved how good their Royal Eight speaker could be, with performance essentially comparable to that from earlier 12-inch speakers. In a small cabinet with a single speaker, the performance was better than would be expected from standard console radio receivers, and when four units were mounted in a single housing, the output at the lower frequencies was remarkable considering the size of the basic cone speaker. Also on display were the high-fidelity headphones, which consist essentially of a pair of minute cone speakers mounted in receiver cases and equipped with sound-proof pads to ensure good coupling between the units and the eardrums.

Pickering & Company, Inc. presented a modern display showing drawings of their units in normal position, and augmented with the actual components alongside. A number of the model 180L column loudspeakers adorned the room, and the choice of music showed off the performance of the speakers to advantage. Most striking of the demonstrations was the performance of the model 190 arm playing on a turntable an angle of 45 deg. from the horizontal, showing the remarkable balance of the arm, with its

cartridge, during the playing of records on normal turntables.

Presto Recording Corporation displayed a full line of recording equipment for both tape and disc. A new professional model of tape recorder, designed to mount either on a rack or on a conventional recorder console, was shown for the first time, and its many features pointed out in detail. The smaller Model PT900 was also on display, as were a number of different models of disc recording machines of varying capabilities. The large tape machine is designed to operate either directly or remotely, and it provides for the 10-inch reels on NAB hubs. Both of the basic Presto chassis are three-head models, and permit simultaneous monitoring of the recorded signal during recording.

Radio Corporation of America exhibited two physical arrangements of its tape recorder, one being rack mounted so that the functioning of the mechanism could be studied readily without the necessity of crawling into a console. Mounted in a console cabinet, the same chassis becomes a more-familiar design of recorder, and can be controlled remotely if desired by a similar set of operating controls. Also shown in the room occupied by the Engineering Products Department was the new Starmaker microphone, a miniature ribbon microphone designed for use on audience participation shows or on television where the performer should not be hidden by the microphone. Two cabinet mountings for the LC1A speaker were also shown and, with a signal of undoubted quality from the tape recorders, showed excellent characteristics.

In another of RCA's rooms the new model of the duo-cone speaker—the 515S2—was on display, both visual and aural. This unit is lower priced than the LC1A, but gives the listener who wants good quality a high degree of performance with a two-way unit combined in a single housing.

Radio Music Corporation displayed a number of professional-type transcription pickups, using a single arm and three interchangeable heads. One head is designed solely for lateral transcriptions, another solely for vertical, and a third serves to play both about equally well. Also on display were a number of amplifiers for wired music systems, restaurants, and other such applicaitons where continuous reliable operation is required. A new line of speakers and speaker housings were shown, with performance better than would normally be expected from a study of the cabinet dimensions.

Rangertone, Inc. exhibited their lip-sync system which permits the use of ¼-in. magnetic tape with sprocket hole driven motion picture film at a considerable saving in cost over the use of optical film for the sound recording. By recording a 60-cps signal from the camera motor supply at the same time as the sound is recorded, it is possible on playback to compare the 60-cps recorded signal with the frequency of the power supply driving the projector and to vary the speed of the tape recorder so as to keep the sound track in exact synchronism with the picture. This is an important improvement in tape recorders, and is resulting in their wider use in motion picture production.

Reeves Soundcraft Corporation presented a modern display of magnetic tape in several dimensions and spoolings along with a variety of recording discs ranging from 6 inches up to 17½ inches in diameter. Newest products of this company include a line of TV picture tubes, principally of the dark face rectangular types which are being used almost exclusively in current production sets. With this diversification, the Reeves line is now usable in practically all branches of the electronic entertainment field.

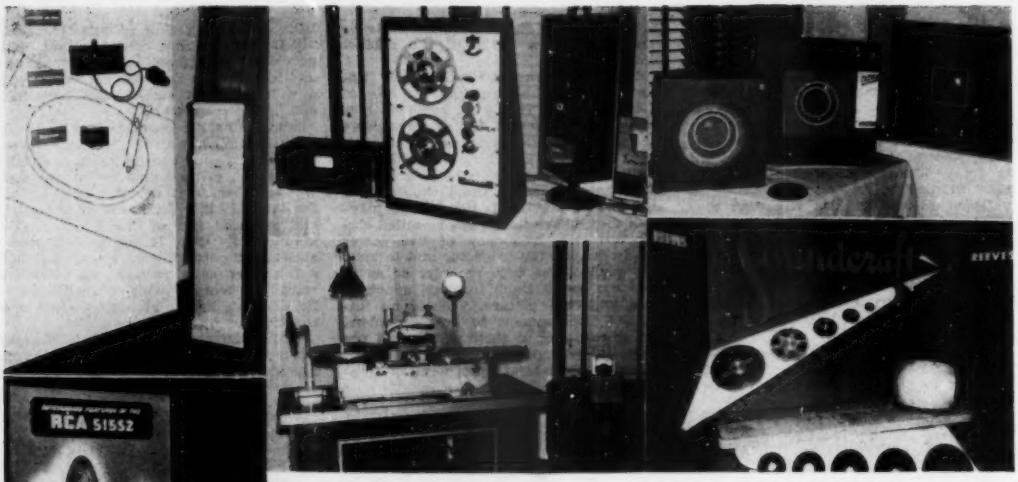
Rek-O-Kut Company, Inc. displayed a variety of turntables and disc recording mechanisms, together with amplifiers for use in recording and playback. Outstanding among the turntables is the heavy-duty type with hysteresis motor drive, having the smoothest of drives and a minimum of external hum fields. The use of a 6-inch speaker in an especially designed cabinet was noted as an eye-opener as to the quality of tone obtainable. For applications where an inexpensive monitor speaker is desired—as in schools or other places where the budget does not permit the use of more elaborate systems—this model would be ideally suited. The Rek-O-Kut line also includes a variable speed turntable, adjustable over a wide range, and several transcription players designed for portable use.

Hermon Hosmer Scott, Inc. exhibited the model 210-B Dynaural Amplifier, along with several smaller items of equipment intended for use with phonograph reproduction systems to reduce the needle scratch usually heard from shellac records. The new units also operate to reduce pops and crackles from LP's and other plastic records. The basic 210-B amplifier is a complete unit, with provision for phonograph equalization and has, in addition, tone controls giving a wide range of variation of both bass and treble response.

Scully Machine Company displayed one of their famous recording machines, complete on its own console table, and with microscope, elapsed-time meter, and control switches. This machine, well known for its reliability and ease of operation, still remains one of the finest instruments of its type. It will cut either inside-out or outside-in, with both standard and microgrooves, and has an automatic spiralling feature which contributes to its adaptability in recording studios of the highest quality.

Mark Simpson Mfg. Co. Inc. featured their new Masco Sound-Reel magnetic recorder, with a number of interesting features for a small and inexpensive ma-

Reading clockwise; Midway Radio & Television Corp., Milo Radio & Electronics Corp., Peerless Electrical Products Div. of Altec Lansing Corp., Panoramic Radio Products, Inc., The Permoflux Corp., James B. Lansing Sound, Inc.



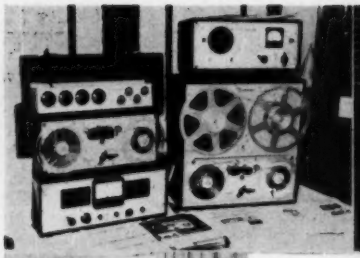
Left, from top to bottom: Pickering & Co., Inc., RCA, (Harrison, N. J.), Rangertone, Inc., RCA (Camden). Above: upper left, Presto Recording Corp.; upper right, Radio-Music Corp.; lower left, Scully Machine Co.; lower right, Reeves Soundcraft Corp.

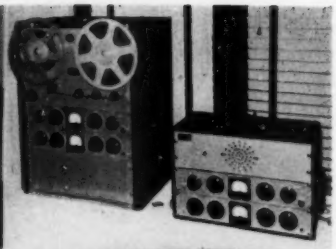
chine. Extremely compact, the Sound Reel will record at 3¾ or 7½ inches per second, and is reversible so as to record on two tracks. Also shown was the small tweeter designed to mount in front of a 12- or 15-inch cone and to be connected across the voice coil of the large cone without any crossover network.

Somerset Laboratories, Inc. displayed their new noise suppressing amplifier with a remote control unit designed to permit the user to adjust volume, tone, and suppression from his easy chair. Also shown were several models of the noise suppressor unit separate from the main amplifier and for use with existing equipment. In one form of the complete equipment a separate control panel is supplied which can be mounted in a cabinet at some suitable spot, permitting the placement of the amplifier at some more convenient location than is usually available at the desired control panel.

Sonar Radio Corporation demonstrated a new tape recorder equipped to handle 10-inch reels and of quality superior to the usual home-type machine. This model is equipped with three heads, permitting simultaneous monitoring of the recorded tape during the actual recording process. Complete in four panels for rack mounting, the unit is approximately 24 inches high, providing for the recorder chassis, record and playback amplifiers, and the loudspeaker and power supply panels. In another model, the recorder chassis is separate, and the amplifiers and speaker are rack mounted units which may be

Below: upper left, Rek-O-Kut Co., Inc.; upper right, Hermon Hosmer Scott, Inc.; lower left, Mark Simpson Mfg. Co., Inc.; lower right, Somerset Laboratories, Inc.





Top row, left to right: Sonocraft Corp.; Stephens Mfg. Co. Inc.; Sonar Radio Corp.; at right, Tech Laboratories, Inc. At left, upper, Sun Radio & Electronics Co. Inc.; lower, University Loudspeakers, Inc. Below, upper row left to right: Terminal Radio Corp.; The Tetrad Corp.; Transit Sound Systems, Inc.; lower row, Triad Transformer Mfg. Co.; United Transformer Co.; U. S. Recording Co

located remote from the recorder unit.

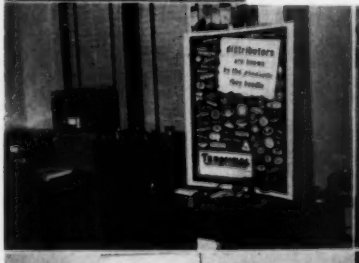
Sonocraft Corporation featured the entire line of Magnecorder equipment, for which they are one of the jobbers in the New York area. On display were both the PT6 and PT63 recorder units, the auxiliary chassis for large reels with the NAB hubs, and several models of amplifier-speaker-power supply units, along with the multichannel mixer for up to four microphones.

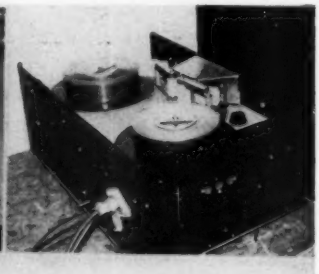
Stephens Manufacturing Corporation exhibited its complete line of speakers and cabinet models, with the two-way systems taking the lead in favor among the visitors. The Hy-Son super tweeter, first shown at the 1949 Fair, is now in complete production, and the addition of this unit to a regular two-way system improves the performance in the upper-highs to a remarkable degree. Stephens models include crossovers at both 600 and 800 cps, and multicellular horns are available in a wide variety of sizes and shapes to fit every requirement.

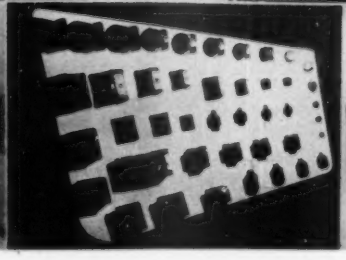
Sun Radio & Electronics Co. Inc., one of the most aggressive jobbers in the New York area, exhibited a new unit known as the Realist—a corner cabinet incorporating a high-frequency speaker directed upwards at an angle from the rear of the unit. In usual hard-walled living rooms, this model gives a remarkable distribution of sound, and by the very realism of the sound source makes the unit live up to its name. Another feature of this display was the presence of a shadowgraph unit on which visitors could compare their own styli with the standard shape for a given type in order to determine if wear had progressed to a degree which would make replacement advisable.

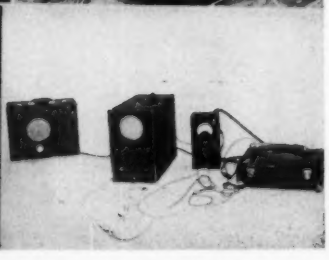
Tech Laboratories, Inc. displayed the artificial reverberation generator developed by Audio Facilities Corporation and marketed solely by Tech. This unit is capable of introducing a controllable amount of reverberation to any signal, and eliminates the need for costly echo-chamber equipment setups for radio sta-

[*Continued on page 53*]





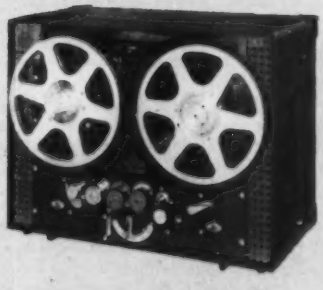




if it's TAPE...it's PRESTO
if it's PRESTO...it's the BEST

PRESTO PORTABLE RECORDER PT-900

Combining the features of machines costing hundreds of dollars more, the PT-900 answers the need for a recorder of ultra-high fidelity in a completely portable, compactly designed unit. Equipped with separate amplifiers for recording and monitoring; individual heads for erase, record, playback; three microphone input; dual speed (15" and 7½/sec.). Frequency response from 50 to 15,000 cps.

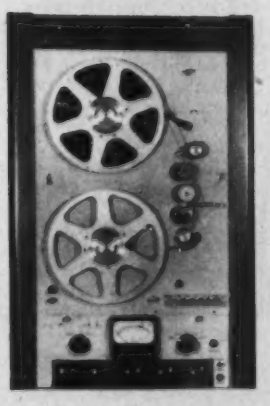


PRESTO PORTABLE RECORDER RC-10/14

This machine is identical to the RC-10/24, except for panel size and selector control. With a panel 19"x14", the RC-10/14 is shown mounted in a durable, leatherette carrying case. Weighing just 68 pounds, this tape transport mechanism has all the audio quality, speed regulation and reliability of a fine console type unit, at a cost far below a studio recorder. PRESTO amplifier (model 900-A2), as shown with model PT-900, is recommended.

PRESTO RACK MOUNTED RECORDER RC-10/24

The number one choice of engineers seeking the finest tape machine for relay rack mounting. Rugged construction and precision engineering combine to bring almost faultless operation. Push-button control, three magnetic heads, speeds of 15" and 7½"/sec.; fast-forward and rewind speed of 250"/sec.; frequency response to 15,000 cps. Accommodates reels up to 10½" in diameter. Panel size: 19"x24½". Constant tape tension assured by torque motors. Illustrated with the PRESTO 900-A2 amplifier, recommended for use with this recorder.



AMERICA'S MOST COMPLETE SELECTION OF FINE TAPE RECORDERS

PRESTO **RECORDING CORPORATION**
Paramus, New Jersey

In Canada: Walter P. Downs, Ltd., Dominion Square Bldg., Montreal, Canada
Overseas: M. Simons & Son Company, Inc., 25 Warren Street, New York, N. Y.

AUDIANA

LEWIS S. GOODFRIEND

High Fidelity

IN THE PREVIOUS ARTICLE, the conclusion was reached that high fidelity defined as the acoustic facsimile—can never be attained using single-channel systems. However, it must be admitted that there are many excellent sound reproducing systems installed in rooms and studios. To reconcile these two facts an examination of the good single-channel systems shows that all of the system components are of the highest quality, and that no compromises have been made in order to save either space or money. In other words, a single-channel system can be made to approach the acoustic facsimile and thus provide pleasing reproduction. After the multitude of listener tests that have been conducted to date, there is little doubt left that the nearer the approach to the facsimile goal the more pleasing is the result.

No manufacturer or designer can say that any sacrifice of quality is justified by the existing inherent spatial distortion introduced by a single-channel system. Such compromises with cost and quality all tend to decrease the acceptability of the unit. Nonetheless, many manufacturers and designers continue to produce units with inadequate frequency compensation for phonographs, insufficient power before acceptable distortion is exceeded, and insufficient power-supply filtering. In listing these three, it is assumed that there is sufficient copper and iron in the transformers to prevent overheating of the power transformer and to prevent saturation in the output transformer.

According to several tests, the perceptible harmonic distortion for both speech and music is one per cent. This is the point at which the distortion is perceived *during* a listener test. A distortion as low as 0.2 per cent may be sufficient to cause auditory fatigue over long periods of listening. Improperly equalized phonograph (and radio) channels and FM de-emphasis circuits cause a response that sounds *different*. This means that the listener cannot associate what he hears with fact. Thus the lack of proper equalization leads to outright annoyance. Finally, if we force our push-pull output tubes to filter the 120-cps ripple out of the high-voltage supply, we have already used some of their power capabilities. The unbalance between tubes in a push-pull stage, unless carefully compensated, will permit an excessive hum level. The distortion caused by unbalance may be less than the fatigue level.

A survey of a number of amplifiers in the medium price range shows that 31 out of 55 have no filter choke ahead of the output-stage high-voltage supply. These figures include an FM receiver specifically designed for quality listening. Without a detailed study of tone controls and variable equalizers, it is still safe to say that equalization is generally achieved without regard to the phase delays introduced by most trick equalizers. And as hard as many have tried to prove otherwise phase distortion changes *timbre*, the quality or body of sound. These seemingly innocent moneysavers are obviously large factors in the lowering of the quality level from a near-facsimile to a merely pleasing system. If there is any question of the reduction of power capabilities by the filtering action in the push-pull output stages, a quick check of the equations in any vacuum tube or electronics text will give the answer.

Power vs. Distortion Curves

The matter of power level and distortion have been detailed before, but the fact remains that many units have a single-frequency distortion rating that is exceeded at many other frequencies. One way to avoid this is to check the maximum output level for the rated distortion level. If the power available at all frequencies is not greater than half the rated power the unit does not meet the power rating and obviously cannot fulfill the requirements of an amplifier of that rated power. This is the major stumbling block for most amplifiers in the high-quality performance group. They are good at low levels, but at high level they just do not seem to fill the room. When a power rating and distortion level are given they should indicate that at the rated power level the rated distortion will not be exceeded at any frequency. In any case, if the distortion at normal output levels is greater than 1 per cent the builder or purchaser should reject it as not suited to his need.

The comments made here are not really a criticism of the manufacturers. They are intended only to point out the need for job-rating amplifiers and designing them with the acoustic facsimile as a goal.

Other components of the single-channel system from microphone or recording through to the loudspeaker are equally important to the quality. However, an excellent group of transducers is available having far lower harmonic distortion from non-linear elements than the acceptable minimum. Few individuals are in a position to design and build their own transducers but here, at least, manufacturers agree on most basic design requirements. A real problem in the use of transducers is to make them cosmetically attractive. But this is no topic for discussion here.

One problem in high-fidelity, always present, is noise, and most frequently, record surface noise. Unfortunately, it is present in most shellac records, even though they are of the highest quality. A good audio system reproduces the noise. It is up to the listener to decide whether to sacrifice musical fidelity to achieve noise-free reproduction, and most good audio systems include cut-off filters or noise suppressors. But this noise is part of the signal and the *equipment is not to blame* if it reproduces the surface noise along with the desired music. Many of the modern record pressing techniques have helped reduce surface noise and bring our recorded channel nearer to our goal.

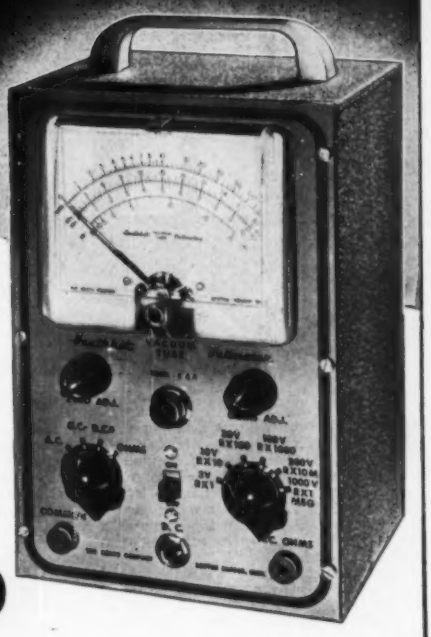
Finally, no delicate set of electronic instruments can remain trouble-free indefinitely. To maintain the quality of transducers and amplifiers they should be properly enclosed, ventilated as required, and subjected to preventive maintenance.

If the acoustic facsimile is considered the goal in audio reproducing equipment design, it becomes easy to provide pleasing quality and results in a satisfied listener. Compromise with quality compromises our objective—high fidelity.

New 1951 • • MODEL V-4A

Heathkit VTVM KIT

HAS EVERY EXPENSIVE *Feature*



- ★ Higher AC input impedance, (greater than 1 megohm at 1000 cycles).
- ★ New AC voltmeter flat within 1 db 20 cycles to 2 megacycles (600 ohm source).
- ★ New accessory probe (extra) extends DC range to 30,000 Volts.
- ★ New high quality Simpson 200 microampere meter.
- ★ New ½% voltage divider resistors (finest available).
- ★ 24 Complete ranges.
- ★ Low voltage range 3 Volts full scale (⅓ of scale per volt).
- ★ Crystal probe (extra) extends RF range to 250 megacycles.
- ★ Modern push-pull electronic voltmeter on both AC and DC.
- ★ Completely transformer operated isolated from line for safety.
- ★ Largest scale available on streamline 4½ inch meter.
- ★ Burn-out proof meter circuit.
- ★ Isolated probe for dynamic testing no circuit loading.
- ★ New simplified switches for easy assembly.

New LOW PRICE **$23.50**

The new Heathkit Model V-4A VTVM Kit measures to 30,000 Volts DC and 250 megacycles with accessory probes — think of it, all in one electronic instrument more useful than ever before. The AC voltmeter is so flat and extended in its response it eliminates the need for separate expensive AC VTVM's. + or − db from 20 cycles to 2 megacycles. Meter has decibel ranges for direct reading. New zero center on meter scale for quick FM alignment.

There are six complete ranges for each function. Four functions give total of 24 ranges. The 3 Volt range allows 33⅓% of the scale for reading one volt as against only 20% of the scale on 5 Volt types.

The ranges decade for quick reading.

New ½% ceramic precision are the most accurate commercial resistors available — you find the same make and quality in the finest laboratory equipment selling for thousands of dollars. The entire voltage divider decade uses these ½% resistors.

New 200 microampere 4½" streamline meter with Simpson quality movement. Five times as sensitive as commonly used 1 MA meters.

Shatterproof plastic meter face for maximum protection.

Both AC and DC voltmeter use push-pull electronic voltmeter circuit with *burn-out* proof meter circuit.

Electronic ohmmeter circuit measures resistance over the amazing range of 1/10 ohm to one billion ohms all with internal 3 Volt battery. Ohmmeter batteries mount on the chassis in snap-in mounting for easy replacement.

Voltage ranges are full scale 3 Volts, 10 Volts, 30 Volts, 100 Volts, 300 Volts, 1000 Volts. Complete decading coverage without gaps.

The DC probe is isolated for dynamic measurements. Negligible circuit loading. Gets the accurate reading without disturbing the operation of the instrument under test. Kit comes complete, cabinet, transformer, Simpson meter, test leads, complete assembly and instruction manual. Compare it with all others and you will buy a Heathkit. Model V-4A. Shipping Wt., 8 lbs. Note new low price, $23.50

New 30,000 VOLT DC PROBE KIT

Beautiful new red and black plastic high voltage probe. Increases input resistance to 1100 megohms, reads 30,000 Volts on 300 Volt range. High input impedance for minimum loading of weak television voltages. Has large plastic insulator rings between handle and point for maximum safety. Comes complete with PL55 type plug.

No. 3366 High Voltage Probe Kit. Shipping Wt., 2 pounds. **$5.50**

Heathkit RF PROBE KIT

Crystal diode probe kit extends range to 250 megacycles ± 10% with all parts, crystal, cable and PL55 type plug comes complete.

No. 309 RF Probe Kit. Shipping Wt., 1 lb. **$5.50**

EXPORT AGENT ROCKE INTERNATIONAL CORP 13 E 40th ST NEW YORK CITY (16)

The HEATH COMPANY

. . . BENTON HARBOR 25, MICHIGAN

EDWARD TATNALL CANBY*

Towards Audio Fair III

THE MANIFOLD BENEFITS accruing from Audio Fair II, held this October, will without the slightest doubt continue to make themselves felt right up until Audio Fair III bursts upon us next fall, a bigger and better show as the result of our experience this year. So, though this'll appear a bit *en retard*, constructive remarks seem definitely in order.

Let me at once praise the management of the Fair as fulsomely as I can, including several officers of this sheet who had, so to speak, an enormous hand in the vast quantity of dirty work that had to be done in preparation. The whole thing was a model of smoothness and efficiency and I can't remember a single flaw of any sort in that smoothness—all was trouble-free and easy, even to the pre-fabricated badges for the entire exhibiting personnel!

However, I have a few small bones to pick with that personnel, and indeed I sort of feel, to use the old phrase, that it's my duty to do so, on behalf of my clients, the musicians and the music-lovers, since I represent a passle of 'em in this magazine.

Let's waste no more words. The Fair was beautifully managed but there wasn't a thing the management could do (other than providing virtually sound proof rooms) to reduce what became by the final day a most frightening bedlam.

Look, gentlemen of the Audio profession —this is from the horse's mouth. I know you had a lot of powerful equipment to demonstrate and the neighbors made so much noise that you had to whomp up your 50-watters to drown 'em out. I also know that there were thousands of engineers, radio servicemen, and others whose interest was not so much musical as technical. Those numerous individuals had to be catered to. The dealers who sell audio parts were there, as well as the makers who needed to find out what was what outside of their own bailiwicks. All of which is conducive to noise.

But as this column has said again and again (and no further back than the October issue), the business of Audio is music. The purpose of almost all Audio in the quality field is music. What, then, of the people who acquire Audio in order to hear music? What some of you may not realize is that these people were also present at the Audio Fair, by the thousands. Some were engineers too, professional or amateur; many had dabbled in technicalia enough to feel some confidence at the sight of a battering ram woofer, about to give with the bass. Most, on the other hand, were suddenly launched into an unfamiliar and decidedly strange environment, to put it mildly.

Think this way: our industry has expanded enormously in the last couple of years—that, after all, is the very reason for the Audio Fair itself. But that expansion has been largely via conversion of many music lovers to "hi-fi," about which you can be dead sure, almost all of the converts knew nothing whatsoever, previously. That means that most of them (the ones who are out buying up expensive audio equipment) still know very little about the technical aspects and—here's the point—are decidedly awed by the professionals and the heady shop talk, as any green-horn is, who suddenly finds himself in the Holy of Holies, the very temple of Audio! Most of our converts, then, are given to extreme timidity. Which doesn't indicate any lack of interest; merely a lack of aggressiveness in the presence of audio people.

Now, as I saw it, things went something like this. Most exhibit rooms were crowded with on-listeners. (Like onlookers—get it?). Up front and aggressive were the engineers, the sales people, the manufacturers, the professionals, the habitués, the advanced and long-time amateurs. These people, very much at home and thoroughly aggressive did all the talking, asked the questions, put out with opinions, looked big and important.

However, perhaps half of the people in each exhibit were acting mousy. They snooped around quietly, saying nary a word (for fear of making a boner), listening respectfully over peoples' shoulders, hastily backing out of any argument. These were the neophytes, the unsure, audio-wise. They were, in large measure, the converted music lovers. And though they didn't say much, though they acted mouse-like, they were having thoughts, you may be sure. And they were looking for music. Looking for audio equipment that could give them the music they wanted.

[*Continued on page 55*]

* *270 W. 4th St., New York 14, N. Y.*

Pops

RUDO S. GLOBUS*

SEVERAL WEEKS AGO, I received a letter boldly typewritten on bold paper by a bold soul who has made his name in this world by writing record reviews for whatever bold publications would pay him. Now retired and content without the mantle of glory weighing on his shoulders, he indicated that he has been out of the business for a long time, liked some of the conclusions that I have drawn, and requested that I get together with some of the big people in the business and find out how they feel about things.

Ever willing to comply with all legitimate requests, I arranged for an interview with one of the really great men in the business and we talked for well over an hour about all things pertaining. The interview was arranged with the background of a long evening spent at Eddie Condon's and the genius of Edmund Hall echoing in my ears. In the history of Condon's, I can't remember any group which can top the one that is now holding forth. Made up of Cutty Cutshall on trombone, "Wild Bill" Davidson on trumpet, Gene Schroeder on piano, and Edmund Hall on clarinet, the group is valiantly putting Humpty Dumpty back together again. One of the big reasons is the still enlightened and smoldering blowing of Mr. Hall, who boasts that he never took a legitimate lesson in his life and won't be bothered with all the technical exercises and practicing that characterizes lesser men.

So . . . to get to the point . . . we asked Edmund Hall the leading question:

"How do you feel about recording jazz under studio conditions?"

The answer is scribbled down on over twenty pages of yellow stock, but it adds up to just one thing . . . he doesn't like it. The reasons are good and are pretty much in line with the stuff I've been writing for months. Ed says that he and practically every other jazz man freezes in a studio. You can't loosen, you can't relax. What

[*Continued on page 38*]

* *960 Park Ave., New York 28, N. Y.*

BEATEN PATH

90% of those who exhibited at the New York Audio Fair — many of them presenting new models for the first time and with understandable pride in demonstrating only through the BEST equipment — were observed to be using

Audax
POLYPHASE
reproducers

What a striking tribute to this super-realistic performer which, when introduced but a few short months ago, was backed only by our own findings as to its overwhelming superiority! What a remarkable dramatization of the old adage about customers beating a path to one's doorstep!

Thousands of visitors, too, came and listened and were astonished by POLYPHASE's amazing *facsimile* realism. *"Never before such amazing EAR-QUALITY!"* . . . was the unanimous verdict.

Yes . . . and this must mean something to YOU.

The unique technical story of WHY this sensational reproducer fairly revolutionizes listening, is set down in literature which is yours for the asking; but after you have read it all — only YOU can decide what sounds best and most pleasing to your ears. Therefore, see and hear POLYPHASE yourself — compare it with any other reproducer at any price — then YOU be the judge!

AUDAK COMPANY
500 Fifth Avenue **New York 18**

"Creators of Fine Electro-Acoustical Apparatus for Over 30 Years"

"The Standard by which Others Are Judged and Valued"

Available with the new compass-pivoted Audax Arms as well as for Record Changers

One single magnetic unit plays all home records.

POPS

[from page 36]

with green, red, yellow, orange, purple and blue signal lights flashing at you, with a time limit to meet, with a pre-arranged idea of what you're going to do, it just doesn't work out . . . and why?

Hall is very sensitive about recording technique. When I asked him the usual question about the best recordings, his initial answer referred to recordings that were "cleanest." His first list included those that had the least surface noise and the best balance, and sounded remotely like the original. When we complained bitterly about such criteria, we got an answer which was more to the point. The best ones were impromptu sessions . . . walking into the studio cold with no idea of what was going to happen and then letting loose. And here Hall gave us the big idea of the moment. You have to have an audience in order to play jazz. It just doesn't feel right to sit in an empty studio and play into a mike. There isn't a mike made than can respond in the way a live audience does. No matter how good some recordings are, they're nothing compared to the kind of stuff that could and would have resulted from genuine jazz conditions.

Ed's been in the business for a long time. He made his first recording in 1926 for Victor with the "Ross DeLuxe Syncopators" from Jacksonville, Fla. The recording was made in a tobacco warehouse with one mike and some impromptu drapes hung indiscriminately around the barn. He has no illusions about the "Great Old Days." He prefers modern studio conditions, but puts the finger right down the line and points squarely at the people who haven't learned the big lesson about jazz recording yet. It goes something like this:

"It's O.K. to call up any bunch of guys to do a legit date. Any guy who plays good and can read music will do fine for a regular recording session. But for this kind of stuff (dixieland and the rest) you gotta have the right men. If you don't have the right men, it's no good."

These are the words of a jazz man who's known all the greats in the business, played with all of them, and is not prone to telling stories out of school. The right men don't grow on every tree. There are only a few clarinet players, trumpet and trombone men, pianists, drummers, etc., who can play jazz. As Ed puts it . . .

"Any good man can sit in on a session cold, and as long as the piano man knows the chords and the trumpet can blow the melody, we can handle it."

But in this day of the all-wise musical director, it would not be too far-fetched to expect to find Jascha Heifetz playing lead fiddle in a recording session doing a combo of Muskrat Ramble and Jazz Me Blues. This is not professional snobbery, nor is it resentment, because all the big men are making a lot of money. It is simply a statement of fact which is emphasized by the naming of those (which we can't do here) who have become the leading lights in modern jazz recording. Hall comes out openly and says they don't know what it's all about. They may sell a few records, but in the long run it doesn't pay off because the stuff is second rate. Hall agrees completely with the thesis that the way to record the stuff is to find the perfect combo and catch them at the job. Tape record all night and edit the next day. The men are really loose during the session and even if three quarters of the stuff is worthless,

there'll be enough to fill both sides of an L.P. But, with reference to the way things are now, Ed puts it on the line.

"It's not what you can do . . . it's who you know."

That is the trite but true comment on the record business set up now. In the old days, with after-hour sessions when musicians got together, the big men stood out. There was never any question about it. These were the sessions that used to produce the big moments and were the heart of good jazz. These were the conditions for perfect jazz recording. Today, with the domination of music directors, the powers that be don't know how to pick the right men, depend upon pull and reputation, and what remains is a pretty tired speciman of a good thing. There is further the problem of good days and bad days, and the final decision as to what should be pressed and what shouldn't.

Hall used to be the standout at Cafe Society Downtown during the rough and ready days, and there is no wonder that his list of "best" recordings dates back to those days. Heading the list are two discs that Hall picked out primarily because everybody was relaxed on the date. The first was a complete impromptu. Hall and the men showed up at the session with no idea of what they were going to do. It was the first date for Commodore and they decided to do two blues sides. What resulted was the memorable Uptown and Downtown Cafe Society Boogie. One side is fast blues, the other slow. The other select record was the great Commodore 10-inch of The Man I Love, featuring Emmet Berry on trumpet, Eddie Haywood on Piano, Sid (Big Sid) Catlett on drums, and of course the great E. Hall on clarinet.

In the classical group there are the great 12-inch discs that Hall did for Blue Note of High Society and Royal Garden Blues, all done with the original Cafe Society crew. If you listen to these, what strikes you immediately is the obvious superiority of the 12-inch over the 10-inch size. The list is incomplete without the five great sides on Commodore that Ed did with Teddy Wilson, Jazz Quartet, on 10-inch, produced the superlative recordings of "Night and Day," "Out of Nowhere," "Caravan," "Showpiece," and "Sleepy Time Gal." All the recordings are rare and marvelous manifestations of really great jazz clarinet playing and pretty much highlight the inimitable Hall style. Ed, of course, disclaims style and points to the fact that there were things he did fifteen years ago that he wouldn't do the same way today. But there is still something consistent throughout.

Coming out shortly on the Victor label are a series of things that Hall points to with pride. Recently recorded, there is a job on "Walking the Blues" that Ed did with Gene Krupa, Joe Bushkin, Cutty Cutshall, Wild Bill Davidson and Ernie Cassires (whom Hall considers the great baritone sax in the business). The same date features a job on "I'm Forever Blowing Bubbles" and "The Kiss my Sweetie Gave to Me." The group sounds magnificent and it should be a good chance to see what progress the big companies are making on the jazz front. Hall says to watch out for them . . . we will.

Specialized Pot Luck:

For months, gossip colums, magazine articles, radio programs, et al have been plugging away at something called the "greatest voice in the world." Going by the name of Yma Sumac, the singer has a range of over four octaves, is a *femme fatale*

of the old school and according to the blurbs released by her press agent is the "greatest singing discovery ever to be found inside the frame of the most alluring woman in the world."

It was therefore with trepidation that I tore off the cellophane covering of a 45-r.p.m. album called the "Voice of Xtabay." With trembling fingers I examined the "alluring" portrait of the Inca singer and read the blurb which featured such hot bits of prose as "child of the Andes peaks," "thrilling authenticity," "yet it is all one voice . . . one alluring young woman," etc. The fabulous one is singing Inca music and lyrics by Moises Vivanco, who is said to be a specialist in this sort of thing and is assisted by one Leslie Baxter who is responsible for conducting and arranging the background. If my memory serves me right, Baxter is responsible for some other rare gems, such as "Music out of the Moon," featuring The Theremin and various other oddities.

I have listened to all eight sides of this album and wish to make the following pronunciamento. I am full of admiration for Capitol Records and their audacious enterprise in revealing to the world of ears these wondrous things. But again, they have taken something which is essentially good and crummed it up with some of the most vulgar arranging and trite special effect recording to be heard in a long time. Sumac is indeed marvelous. She does have an extraordinary range and can project dramatic quality beautifully. She has not been helped by ridiculous overorchestration of primitive music and simply bad orchestral effects. The striking quality of the music is lost under the heavy sway of the lushest of impressionistic orchestration techniques. Those who know authentic South American Indian music realize that it isn't helped by sophistication. The same recording date with a small native group behind the marvelous Yma would have been notable. Therefore . . . cheers to Capitol records for the enterprise, bravos to Miss Sumac for the voice and "allure," curses to Mr. Baxter for poor taste. In any case, you really have to buy the thing. In its present state, it is a novelty which had marveolus potentialities (Miss Sumac is a significant combination of Erna Sach and Sophie Tucker), which can be listened to with open mouth and dilated nostrils.

LOUDNESS CONTROL

[*from page 18*]

be pointed out, however, that there is an insertion loss of 6 db which must be compensated for in low-gain systems if full output is required. Also, the unit is not satisfactory for operation in the plate circuits of high-impedance tubes since its input impedance is not constant at or near full volume settings. Impedance is fairly constant if the control is used up to approximately 75 per cent of its rotation.

The three-section control required is readily assembled with a standard IRC type Q Volume Control and two IRC Multisections. The Multisections are rear control sections so designed that they may be added to Type Q Controls or to other Multisections in the same manner as switches are attached. Simple

assembly instructions are included with each Multisection. A pictorial schematic of the assembled unit is shown in *Fig.* 3, while its over-all appearance is shown in *Fig.* 4.

Demonstration Unit

Those who wish to demonstrate the remarkable difference this new control can make in producing a pleasing, well-balanced sound output at low volume levels over the results of an ordinary,

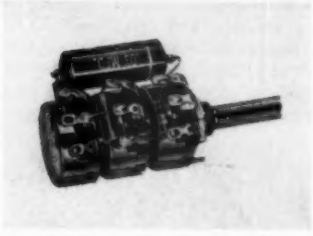


Fig. 4. External appearance of completed control.

uncompensated volume control may assemble a very effective demonstrator unit with the use of the new IRC Concentrikit, an arrangement which permits the quick assembly of a wide variety of concentric controls. When used in conjunction with Multisections will provide a triple-single concentric control, shown in schematic form in *Fig.* 5.

The outer shaft of this demonstrator unit varies the panel section R_1 which is

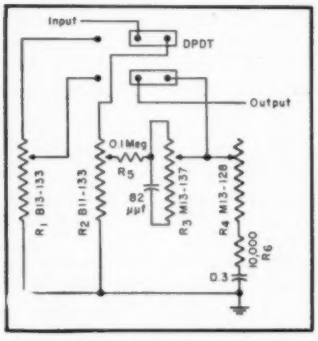


Fig. 5. Schematic of demonstrator unit used to show advantages of the new loudness control.

an ordinary uncompensated volume control. The inner shaft varies the three rear sections, R_2, R_3, and R_4, which comprise the continuously variable loudness control. By means of a d.p.d.t. slide switch the output is adjusted for the same volume level through each control at 1000 cps and direct comparison may be quickly made at low level. Appearance

of the completed demonstrator unit is shown in *Fig.* 6.

Following are simple assembly instructions for both the continuously variable loudness control and the unique demonstrator unit.

Assemble to the "Q" control the two specified Multisections, in the order shown in *Fig.* 3, using instructions included with each. Assemble the additional parts and make all required connections as shown, solder, and cut shaft to required length. Install and wire into any high-gain audio amplifier.

To construct the demonstrator unit, assemble Concentrikit by following instructions included using B13-133 (R_1) as panel unit and B11-133 (R_2) as rear

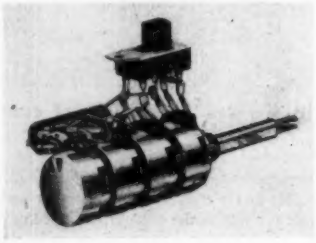


Fig. 6. External appearance of demonstrator unit.

unit. Omit cover on rear. Assemble M13-137 (R_3) and M13-128 (R_4) per instructions included with each Multisection. Attach this assembly in place of rear cover on the above Concentrikit being sure inner shaft rotates both sections R_3 and R_4. Assemble the additional parts and make all required connections to the last three controls R_2, R_3, and R_4 in exactly the same manner as described previously for the loudness control. An additional connection is required between the most counter-clockwise terminal of the panel section and that of the second section to form a common ground.

Assemble d.p.d.t. switch as shown by photograph of completed control, *Fig.* 6, and make necessary connections as shown by schematic, *Fig.* 5. It is advisable to ground the metal case of switch, if that type is used, to reduce possibility of hum pickup during operation of switch.

(All wiring to and from control should be as short as possible and should be shielded to reduce hum pickup. Use low-capacitance wire to avoid loss of highs due to shielding. The complete assembly can be mounted in a small steel box to form a well shielded unit.)

UNKNOWN IMPEDANCES IN TRANSFORMER

[*from page 21*]

must, of course, be found first in order to make the formula operative.

Impedance, being made up of resistance, can be determined by Ohm's Law applied to those circuits having impedance. The formula for Ohm's Law in a.c. circuits is:

$$Z = \frac{E}{I} \qquad (2)$$

Where E = e.m.f., in volts
I = current, in amperes
Z = impedance, in ohms.

Procedure

Adjust the output of the audio oscillator to about 25 volts on the meter. Apply this voltage to one winding of the transformer under test and at the same time measure the current drawn. (See *Fig. 2.*) Since reflected impedance from

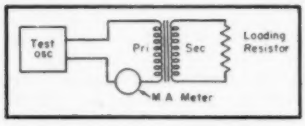


Fig. 2. Schematic of arrangement used for measuring voltage ratio between transformer windings preliminary to calculating impedance ratios.

secondary to primary under load will have an important bearing on the final result, the secondary of the transformer under test should carry a load. This can be a resistor, a speaker or a pair of headphones as an example. If a resistor is used it should be of the non-inductive carbon type to avoid reflected reactance. Once two known values are found, the impedance may be calculated from the above formula.

A more accurate method of making the measurements is to treat the primary of the transformer as a choke, leaving the secondary unloaded for the moment, and determine the inductance of the winding and find its reactance. This can be done by substitution as shown in *Fig.* 4.

Adjust R so that the voltage drop across R balances and equals the voltage drop across the primary. The voltage drop across the transformer primary is, of course, not due to inductance alone, but is caused by its impedance. Measure the d.c. resistance of that section of R in which the voltage drop occurs, then solve for the inductance of the primary with the formula: $L = \frac{R}{2\pi f}$. Once the in-

ductance is known, the inductive reactance (in ohms) of the primary may be found by the formula: $X_L = 2\pi fL$. Then the impedance may be found by measuring the d.c. resistance of the winding with an ohmmeter and solving for the impedance with the formula:

$$Z = \sqrt{R^2 + X_n^2} \qquad (3)$$

Where Z = impedance
R = d.c. resistance
X_n = Net reactance.

Since we are substituting X_L (inductive reactance) for X_n in the above formula, it is assumed that the net reactance is equal to the inductive reactance. This

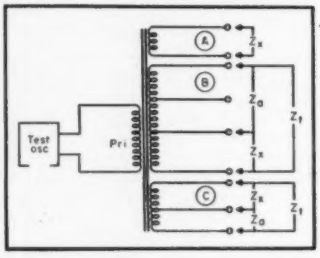


Fig. 3. (A) Method of measuring voltage ratio of simple transformer. (B) Tapped transformer measurements give sufficient information for complete calculations. (C) Example of tapped transformer.

is not completely accurate, but the result is sufficiently close to make the transformer usable in many audio applications.

With the proper load on the secondary the impedance reflected back to the primary would be such as to lower the primary impedance considerably. For general application this can be assumed

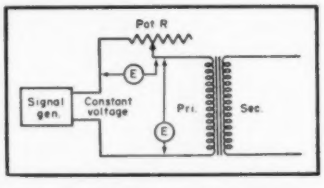


Fig. 4. Method of making measurement by substitution. Signal Generator voltage is kept constant while adjustments are made. The technique is described and formula given in the text.

to lower the primary impedance to one fourth. This gives the primary impedance *at the lowest frequency responses of the transformer.*

With the impedance of the primary winding known and with the output of the audio oscillator still applied to the

primary, but with R removed, voltage ratio measurements can be made on the secondary winding, as at A in *Fig.* 3, and its impedance determined by the formula (*1*). Succeeding measurements and calculations can be made on any number of multiple secondary windings.

Tapped Winding Calculations

Now suppose we have a transformer with a tapped winding in which the impedance of two sections is known, but the third unknown, as at B in *Fig.* 3. The impedance of the unknown section can be calculated from the formula:

$$Z_x = Z_a\left(\sqrt{\frac{Z_t}{Z_a}} - 1\right) \qquad (4)$$

Where Z_x = unknown impedance;
Z_a = impedance of known section and
Z_t = total impedance of sections Z_x and Z_a.

In order to make our impedance calculations complete for a given transformer, it is not only necessary to know the impedance of individual windings and tapped sections, but also those tapped windings *on the same core in combination*. The commercially made variable impedance transformers have this information in chart form for easy reference. Such ready information makes the transformer more versatile for any given application and saves the builder much time and many a headache. We can index the impedance for our transformer in the same manner. The third and last formula makes this completeness possible.

Suppose we have a transformer in which we have a two-section tapped winding having impedances of 500 ohms and 10 ohms respectively, as shown at C in *Fig.* 3.

Substituting in the formula:

$$Z_x = 10\left(\sqrt{\frac{500}{10}} - 1\right)^2 = 368 \text{ ohms.}$$

The impedance of any other tapped winding combinations can be calculated in the same manner.

Note also that in this formula it is not necessary to know the primary impedance. The calculations deal with only the knowns and unknowns of the secondary windings. The resultant values apply to tapped windings on the same core; this fact should be kept in mind when making calculations employing the last formula.

VECTOR SLIDE RULE

[*from page 20*]

$\theta = 0.9$ when $\theta = 1.47$ approximately, and *tanh* θ becomes about 0.9951 when $\theta = 3.0$.

Minimum-Loss Networks

An impedance-matching device is occasionally required which may nevertheless introduce a certain amount of loss into a system. In order to keep this loss at an absolute minimum, a transformer is often indicated to accomplish the impedance match.

Where some additional loss is permissible, a "minimum-loss" resistive attenuator can often be used. When its loss can be tolerated, the attenuator is often much less expensive than the transformer, and is smaller and lighter.

The minimum amount of loss which a "T" attenuator must be designed to introduce is determined by the ratio of the impedances which it is intended to match. The resulting actual design is an "L" pad, based upon the "T" pad circuit previously discussed. However, when the pad is designed for the minimum possible amount of loss for a given impedance ratio, R_2 vanishes and only R_1 and R_3 remain to be calculated (see *Fig.* 6).

A procedure for the design of minimum-loss pads is based on the equation[3]:

$$\theta = \cosh^{-1}\sqrt{Z_1 Z_3}$$

In this formula, θ is the loss of the attenuator in nepers (= loss in db divided by 8.686). Z_1/Z_3 is the ratio of the impedances to be matched, so chosen that the ratio obtained is greater than unity.

The procedure is as follows:

1. Obtain the ratio Z_1/Z_3 on scales *A* and *B* of the "vector" slide rule.

2. Record the reading on scale *A* of this impedance ratio, and subtract the number 1 from this result. Set the runner to this new value on scale *A*.

3. The runner now indicates on scale *Sh1* or *Sh2* the minimum loss θ in nepers of the desired attenuator. If the ratio of the impedances is less than 2, then θ will be less than about 0.882 and scale *Sh1* is used; for greater impedance ratios, refer to scale *Sh2*.

4. To determine this minimum loss in decibels, divide θ by 8.686. Use scales *C* and *D*.

5. Calculate R_3 and R_1. These resistances are found with the "vector" slide rule, as explained before. Steps 5, 6 and 7 are omitted, since R_2 is not used in the special case of the minimum-loss pad.

Note that R_1 is always located on the high-impedance side of the attenuator.

[3] From "Reference Data for Radio Engineers," Federal Telephone & Radio Corp., New York, 3d Edition, pp. 158–9, by permission.

The pad may match a high impedance to a lower impedance, or vice versa.

The range of the "vector" slide rule allows minimum-loss pads to be designed to match impedances having ratios as great as 100 to 1 (this ratio causing the minimum loss to be 26 db).

It is often difficult to find the correct values of resistances from stock for any certain attenuator. Resistance values can then be selected which can be connected in series or in parallel to give the required resistance values. It is found that the graphical solution illustrated in *Fig. 7* speeds up the work considerably when parallel resistance combinations are needed.

The following rule applies to the use of *Fig. 7*:

> *If a straight-edge be laid connecting points corresponding to two resistance values upon alternate scales, the intersection of the straight-edge with the intermediate scale indicates the equivalent resistance of a parallel combination of the first two resistances.*

Example: If resistors of 100 ohms and 90 ohms be connected in parallel, what is the resistance of the parallel combination?

Solution: The dotted line (*A*) in *Fig. 7* connects 100 ohms and 90 ohms on alternate scales (*1*) and (*3*). The equivalent parallel resistance is read as 47.4 ohms on the intermediate scale (*2*). This process can be continued for more than two resistors in parallel. Suppose that a third resistor of 80 ohms be connected in parallel with those of the example. Dotted line (*B*) connects the resistance already in the circuit (47.4 ohms) with the added value of 80 ohms on scale (*4*), and the new equivalent resistance is found on scale (*3*) to be 30 ohms.

This chart, while simple, is found to be a great time-saver for general use in connection with audio systems.

AUDIO PATENTS

[from page 2]

the pentode section is the mixer. The variable oscillator uses a separate triode.

Each of the oscillators is coupled to a grid of the mixer pentode by adding a pickup coil to the tuning inductor and connecting this to the pentode. Assuming that both oscillators are well shielded and the leads dressed, the main danger of pulling comes from capacitance between the triode and pentode plates within the combination tube; this is indicated by a dotted capacitor in the drawing, and is by no means negligible. The output of the pentode plate contains components of both oscillator frequencies, so that the variable oscillator frequency may be coupled to the fixed oscillator through the dotted capacitor, the lower part of L_1 and the bypass capacitor C_1 to ground. This creates a potential difference between the triode anode and grid.

To prevent pulling, C_2 is connected between the pentode plate and the upper end of L_1 which is connected to the grid through C_1. This forms a bridge, the arms of which are the two sections of the coil, the ca-

pacitor C_s, and the dotted capacitance. When the bridge is balanced by correct adjustment of C_s, feedback from pentode plate to triode plate in balanced out, and the obtainable audio frequency is much lower than before. As an illustration, if L happens to be centertapped, C_s and the dotted capacitance should be equal.

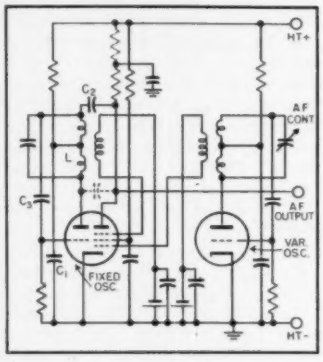


Fig. 2

TECHNICANA

[*from page 8*]

all the requirements of that country's broadcasting service.

Some of the ideas presented here offer a fresh approach to the problem for U. S. and European readers, and although frequent reference to American sources is made, their use is not without understanding.

British Hearing Aid

The design of hearing aids in Great Britain is as controversial as elsewhere, and in *Wireless World* for August 1950 A. Poliakoff describes some of the factors affecting one particular British model.

Listed as the attributes of a good aid in order of importance are optimum volume, avoidance of pronounced peaks, low case noise, and a "nice looking response curve." The optimum volume is a point which the author has studied over a period of years and concludes is within the range 75 to 98 db above reference. In addition, compression is added so that no bad transients will affect patients with recruitment, and also that the optimum level may not be exceeded. For low level signals, a.v.c. action is used. The use of baked lacquer on the smooth metal case minimizes case noise. Hinges are eliminated by a sliding case lock *on the inside*. The frequency response is varied by use of different earpieces, and not by changing amplifier response. Finally, the cost of aids is discussed in relation to radio receiver prices.

Transistor Noise

The application of transistors to the solution of various audio problems has been limited, to date, by their high noise level. H. C. Montgomery discusses this problem in the September 1950 *Bell Laboratories Record*. Transistor noise level is a function

of the biases on the emitter and the collector electrodes, but its spectrum shape is constant. The octave noise level is constant throughout the spectrum which means that the noise power in the 50–100 cps octave is the same as that in the 20 to 40 kc octave. The noise therefore has a predominantly large low-frequency character. For an average Type A (Bell Telephone Laboratories) Transistor in a single-stage amplifier, the noise is 80 db below undistorted output in the 100–3,000 cps band and 75 db down for the 10-cps to 1-mc band.

Conference Telephone

An advanced design conference telephone system is described in the *Ericsson Review*, No. 1, 1950 by G. Thames. The new system known as the Ericsson DYA permits conference calls to be carried by microphones and loud speakers in addition to the telephone handset. The entire system is compatible with PBX or public telephone exchange systems and may be used without disrupting regular telephone service. In the DYA system any extension telephone may be designated as *master station* for the conference system. At a master station, it is always possible to maintain secrecy, since the main station has control over who is connected to the conference. The lines connected to the conference are always indicated by lighted bulbs with numbered lenses. Also PBX (local internal) calls may be interrupted and the conference line used with the PBX line held until the end of the conference call, at which time the PBX call may be picked up from the held position.

The remainder of the article discusses the detailed operation and installation of such a system and describes the components.

AUDIO DESIGN NOTES

[*from page 22*]

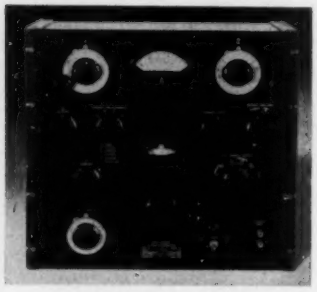
amount of power radiated by the port is approximately proportional to the area. In practice, this means that for a given resonant frequency the larger the enclosure the larger will be the port and the more effective the resonator. Usually, one does not use a port area less than half, nor more than twice the cone area.

The importance of sturdy construction of the cabinet can not be overemphasized. Motion of the walls absorb energy which would otherwise have been radiated from the port. It is good practice to stiffen the back and front of the cabinet with 2 x 4's. The force produced by the voice coil might be as high as 5 lbs. at the resonant frequency and the enclosure must be able to stand this force without rattling.

In order to eliminate radiation from the port at higher frequencies the interior of the enclosure is usually lined with some absorbing material such as Celotex. The material used should have high absorption at the higher frequencies (500 cps up for example) but negligible absorption at the resonant frequency. The objection to simultaneous radiation from the port and cone is that destructive interference occurs at certain frequencies causing large dips in the response curve. This difficulty does not occur at the resonant frequency because here the radiation from the cone is negligible compared to the radiation from the port.

NEW PRODUCTS

● **Audio Generator.** Designed essentially for supplying the two-tone test signals necessary for intermodulation measurement, General Radio's new Type 1303-A audio generator is equally well suited for use as a general purpose beat-frequency oscillator. It may be used to generate a single low-distortion signal adjustable in frequency from 20 cps to 40 kc; two signals, each separately adjustable, one to 20 kc and the other to 10

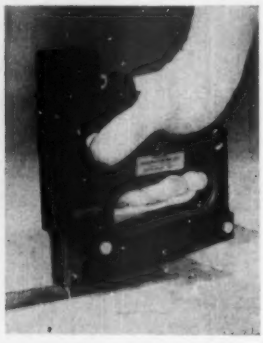


kc; or two signals with a fixed difference in frequency maintained between the two as the frequency of one signal is varied. The fixed difference frequency is adjustable up to 10 kc, and the lower of the two frequencies is adjustable up to 20 kc. Output of the generator is continuously adjustable up to 10 milliwatts into 600 ohms with less than 0.25 per cent distortion. Calibration is in both volts and db. Descriptive material may be obtained by writing General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass.

● **High-Quality Speaker.** Both high-quality reproduction and moderate purchase price are features of the Model 515S2 speaker recently introduced by RCA. Useful response range is 40 to 12,000 cps and power handling capacity is 25 watts. The vibrating system of the 515S2 consists of two voice coils and cones excited by a single 2-lb. Alnico

V magnet. The woofer and tweeter are so mounted that the larger cone is effectively a continuation of the smaller, and as a result the two cones vibrate as a single unit in the crossover-frequency range. Thus is avoided the distortion which frequently is present when woofer and tweeter are operated in different planes. Technical description may be obtained from Tube Department, Radio Corporation of America, Harrison, N. J.

● **Cable Tacker.** Of particular interest to installers of sound equipment and juke boxes is the Phillips cable tacker, a one-hand-operated tool which handles all sizes of cable up to ½ in. OD. Concave center guides instantly center both large



and small cables which are anchored without damage to insulation. Full description may be obtained from Phillips Manufacturing Company, Minneapolis, Minn.

● **Miniature Attenuator.** Following today's trend toward miniaturization of electronic components, the new Daven Series 730 T-network attenuator offers 30 steps of attenuation in a unit only 2¼ in. in diameter. Available in steps of

0.5, 1.0, 1.5 or 2.0 db, the unit has a flat frequency characteristic to 30 kc. Resistance accuracy is ±5 per cent. Zero insertion loss and constant input and output impedance are also characteristic of the new attenuator. Further information may be obtained by writing The Daven Company, 191 Central Ave., Newark 4, N. J.

● **Audio Oscillator.** Exceptionally compact in size, the new Model 510-A oscillator has a frequency range of 18 cps to 210 kc in four decades, and has output constant within 0.5 db over the entire frequency range. Power output is 10

volts into 10,000 ohms with distortion less than 0.3 per cent from 100 cps to 15,000 cps, and rising no more than 0.5 per cent at 30 cps. Total frequency error due to drift and calibration is less than two per cent. Output control is logarithmic and is calibrated in output voltage. Dimensions are 4 × 5½ × 4 in. Full technical description may be obtained from the manufacturer, The Electronic Workshop, 351 Bleecker St., New York 14, N. Y.

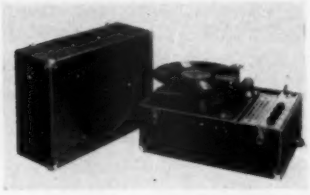
● **Dynamic Microphone.** Full vision for both performer and audience is afforded by the new American type D-33 micro-

phone. Weighing only seven ounces, the D-33 does not require a pre-amplifier, and is distinctively finished in gold and black. Pickup pattern is omnidirectional. Available in all popular impedances. Descriptive material is available from American Microphone Company, 370 S. Fair Oaks Ave., Pasadena 1, Calif.

● **VTVM Kit.** The new Knight VTVM kit brings precision measurements within the reach of even the most modest purse. An excellent all-around test instrument for servicemen, amateurs, experimenters and laboratories, the instrument offers four milliampere ranges and six capacitance ranges in addition to the standard twenty VTVM ranges. Matched-pair resistors are used for accuracy of measure-

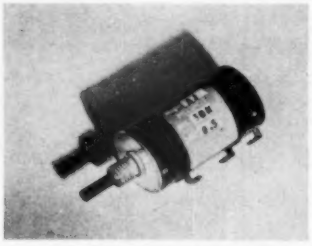
ment. Zero-center d.c. dial is included for FM discriminator alignment. Uses 4½-in. meter. Complete information may be obtained from Allied Radio Corporation, 833 W. Jackson Blvd., Chicago 7, Ill.

● **Record Player-P.A. System.** Portable and self-contained within a single carrying case, the Rauland-Borg Model 1254 record player-p.a. system features a 15-watt amplifier with mixing controls to permit use of phono background with live program material. Three-speed changer is equipped with a dual-type crystal cartridge and is designed to play all types of commercial recordings up to 12 in. Heavy-duty 12-in. speaker is supplied with 35-ft. cable and plug. Weighing only 40 pounds, the entire system is



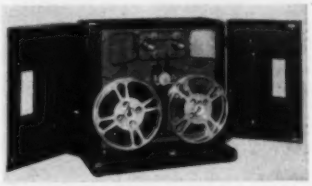
housed in a dark green leatherette carrying case. Full description may be obtained by writing Rauland-Borg Corporation, 3523 Addison St., Chicago 18, Ill.

● **Tiny Precision Potentiometer.** No larger in diameter than a copper cent is the new Model AJ Helipot potentiometer, well suited for both commercial and military applications where space and weight must be considered. Model AJ is a ten-turn unit with an 18-in. resistance ele-



ment, and is available from stock in eight resistance values ranging from 100 to 50,000 ohms. Power rating is two watts and weight is less than one ounce. Further details may be obtained by writing for Bulletin 108 to Helipot Corporation, South Pasadena, Calif.

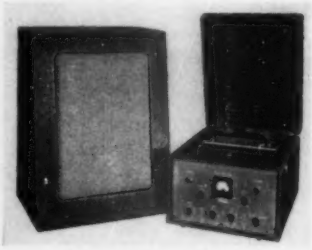
● **35-MM Magnetic Recorder-Reproducer.** Performance standards of the Motion Picture Research Council are surpassed in the new RCA magnetic recording system designed for high-quality professional magnetic recording in film production. The new system is aimed at reducing film and processing costs, and providing greater flexibility in meeting acoustical conditions. In addition to the magnetic record-reproduce unit, the system includes a mixer amplifier, recording amplifier, a bias oscillator for recording, and an oscillator-preamplifier and equalizer for playback. Also included is a self-contained high-and-low voltage power supply. Both 16-mm and 35-mm systems are available, either in portable carrying cases for location work, or as rack-mounted equipment for studio installation. Frequency range of the system is 30–10,000 cps ± one db, flutter is only .04 per cent rms total, and signal-to-noise ratio is 57 db.



● **Intermodulation Meter.** Compact and completely self-contained, the new Model 31 intermodulation meter recently introduced by Measurements Corporation, Boonton, N. J., may be used as a laboratory standard in evaluating the performance of audio systems. The meter is direct-reading in percentage of intermodulation and input volts. Among the uses for which it is well suited are the correct adjustment and maintenance of broadcast transmitters, checking linearity of film and disc recordings, adjustment of bias in tape recording, and for quality control of audio components and equipment. Model 31 is 8 in. high × 19 in. wide × 9 in. deep.

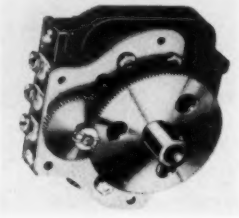
● **Reluctance Cartridge Adapter.** For many users of Western Electric 9A Reproducing Equipment, an adapter head which accommodates a standard variable reluctance cartridge will be of interest because it permits the playing of microgroove records through the regular switch and filter with a minimum of expense for conversion. When the adapter is in use, the impedance of the filter is matched to the reluctance cartridge, and the usual high-fidelity response is assured, together with high output signal. For vertical and lateral transcriptions the regular 9A arm is plugged back into the arm, giving complete flexibility of playing equipment. Further information is available from the manufacturer, Broadcast Service Co., Arcade Bldg., St. Louis 1, Mo.

● **Tape Recorder.** Although moderately priced, the new Sonar Model T-10 tape recorder is claimed by the manufacturer



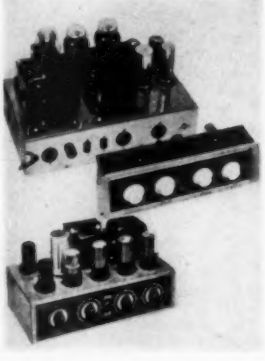
to meet performance standards fitting it for many types of professional application. Amplifier response is 20 to 20,000 cps ± 1 db, and tape response is 35 to 12,000 cps at 7.5 in. per second, according to the manufacturer. Double-track automatic-reverse recording mechanism permits one hour of uninterrupted recording or playback. Literature may be obtained free of charge from Sonar Radio Corporation, 59 Myrtle Avenue, Brooklyn 1, N. Y.

● **Motors for Radio Use.** For many applications in radio, small motors with a wide range of speeds are occasionally required. The new Barcol YAZ motor is reversible, and is equipped wjth a geared head; it has high starting torque, and electrodynamic braking for rapid stopping. The motor itself is the shaded-pole type, producing no interference in radio



receivers, and a balanced rotor minimizes vibration. In the open type, as shown, these units are available with speed reductions from 20:1 to 360:1. Closed types can be supplied with speed reductions ranging from 7.2:1 to 1,333,800:1. For full information on this line of motors, write Barber-Colman Co., Rockford, Ill.

● **Grommes Custom Amplifiers.** A new line of amplifiers designed for incorporation into home music systems as well as for high-quality public address installations has just been announced by Precision Electronics, Inc., 641 Milwaukee Ave., Chicago 22, Ill. Available in two chassis types for three models, these amplifiers are equipped with four input channels and



means for convenient switching from magnetic pickup, crystal pickup, microphone, or radio tuner. Model 200 PG has a separate control unit which may be operated remote from the main amplifier chassis, which has a power output of 20 watts with less than 0.5 per cent distortion or 10 watts at 0.1 per cent distortion. Models

50 and 51 are single-unit models rated at 10 watts with less than 2 per cent distortion. Complete specifications may be obtained by writing the manufacturer.

● **Magnetic Reproducer.** Availability of the Type L-6 Polyphase pickup with special connector for plugging into the Webster changer tone arm is a recent announcement of The Audak Company,

500 Fifth Ave., New York 18, N. Y. Once plugged in the reproducer becomes a permanent part of the arm assembly and requires no further adjustment except for stylus replacement.

THE AUDIO FAIR REVIEW

[from page 32]

tions and recording studios. The machine employs a continuous loop of magnetic tape with suitable amplifiers and control circuits so as to add any desired amount of reverberation with a controllable decay time. Also shown was a complete line of attenuators, both of the conventional type and the newer lever type, believed by many engineers to be more convenient in use.

Terminal Radio Corporation exhibited only a small number of the many lines they represent in New York, but featured in their display was the Ampex line of magnetic recorders. Both the 300 in portable cases and the newer model 400 were shown, with performance of the high quality to be expected from the Ampex machines.

The Tetrad Corporation brought a valuable collection of diamonds to the Fair and displayed them in a glass case under the protection of a uniformed patrolman from the city police force. These diamonds were industrials which will be processed into styli for use in pickups, and the total value of the collection was claimed to be $102,000. Also on display were a number of charts showing the faulty tracking resulting from worn styli, together with a number of photos showing the stylus wear resulting from the use on a relatively small number of plays, using both diamonds and sapphires.

Transit Sound Systems Co. Inc. exhibited a new machine which uses a 1⅜-in. tape which plays back and forth on twelve parallel tracks, permitting the playing of a continuous program from 10 to 20 hours long. The machine uses multiple heads, making it possible to play any of six different tracks as selected, on a single channel, or to have six different programs playing on a number of channels, thus giving the listeners a choice of programs. Operation is as simple as a home radio, with a single switch to turn the machine on or off; after running the tape through in one direction, it re-

verses automatically, and continues. Production of this machine is to be started immediately, with completed models expected in from 90 to 120 days.

Triad Transformer Mfg. Co. exhibited a full line of transformers for high-quality audio use as well as for a number of geophysical applications. The popularity of the line of audio and power transformer is attested by the list of users, which includes such names as Gates, Concertone, McIntosh, Magnecord, Presto, Newcomb, Lear, Audio Pacific, Westrex, and others of equal importance in the field. The Triad line, although relatively new to audio, is well established on the Pacific coast, largely because of the ability and reputation of the designer and chief engineer, Lou Howard, who has been responsible for the design and production of quality transformers for many years.

U. S. Recording Company introduced a new portable transcription and record player employing an all-play stylus and reproducing through a small speaker mounted in the cover of the case. The quality of reproduction would serve admirably in applications where a portable equipment would be used, and was considerably above the average for similar equipment. An item of great interest to most visitors was the spring-driven magnetic recorder designed for portable use, and shown as a sample of the work being done in Germany at the present time. It is said that negotiations are being carried on for the manufacture of this device in the United States, and it is thought that such a device would be well received.

United Transformer Company exhibited a complete line of audio and power components ranging from the smallest models used in hearing aids up to the largest used in amplifier service. Also shown were a number of completed amplifiers, following the circuits published in UTC literature. From the performance obtained, it is obvious that the equipment will satisfy the needs of most users, and the wide variety of transformers in the line ensures full coverage of all requirements.

University Loudspeakers, Inc. displayed a number of speakers for p.a. systems of various power requirements, as well as the line of cone speakers, coaxial units, tweeters and horns. One feature of the exhibit was the display of a cabinet containing a three-way speaker system with separate controls on the three ranges. The "highs" channel covered the range from 3000 to 15,000 cps, the "middles" channel covered the range from 300 to 3000 cps, while the "lows" channel covered from 45 to 300 cps. Separate control of these channels made it possible for the listener to determine for himself the effect of varying the response of the sections, and pointed out the need for good balance throughout the entire audio spectrum.

With the closing of the exhibits on Saturday afternoon, both exhibitors and visitors alike began to plan for the third Audio Fair, which will be held in the same place on Nov. 1, 2, and 3, 1951. Many exhibitors have already expressed their desires for the same or for more space, and will of course have first choice of the rooms they occupied this year. Several other organizations not yet represented at the Fairs have already indicated their intention of being in next year, so it is certain to be bigger and better as time goes on.

RECORD REVUE

[from page 36]

If audio people sold only to audio people, our business would be simple enough. But —say it again—the main business of audio is not audio but *music*.

In an exhibit with which I was connected we insisted on keeping the door closed, with a sign, "OPEN—COME IN" on it, because the instant the door opened the *music* we were trying to sell was utterly destroyed.

No music lover worth his salt will listen to more than *one* source of music at a time.

I think we garnered a fine harvest of good will among the mousy music lovers in that exhibit and I see no reason why others should not, in Audio Fair III, share the happy results with us.

Therefore I respectfully—and I hope, constructively—suggest that in future exhibits of audio equipment the exhibitors ponder these principles:

1. Keep your door closed, so that *one* source of music, no more, is audible at a time. Elementary musical principle.

2. Study your room acoustics and deaden one or two walls with cloth, for good sound quality. Adds to the visual effectiveness of your exhibit, as well.

3. Place speakers carefully—in a corner when possible, and at a distance from the spot where visitors congregate. There was enormous variation between good and bad in this respect at this year's show.

4. Remember the timid music lover and respect his intentions: keep the *average* loudness level down low; save your full volume for *short* tests. A good 30-second burst at full volume will do far more to impress your audience than a steady pounding can ever do. With *average* volume low, you will not drive away customers, as too many exhibitors did this year.

5. Use good records, new ones, and make a point of handling them carefully in front of your visitors. Record collectors are highly sensitive about this. A pile of dusty, scratched-up unprotected records is the worst possible kind of publicity for an audio exhibit! Make a point, too, of the music itself, as far as you are able; be aware of what is playing, keep the record album in plain sight. A wise exhibitor will have at least one knowledgeable person on his staff who can show an intelligent interest in music—enough to gain the visitor's confidence. (He doesn't know too much himself, after all.)

6. EQUALIZE! Yes, there are plenty of audio equipment purchasers who want highs, highs, highs. But there are plenty more who want faithful reproduction and are out to buy it. That means correct equalization for the high pre-emphasis in most commercial discs. Your machine will never sound the worse for proper equalization. Again, if you want to demonstrate highs—do it in short bursts. But return to the proper setting in between.

7. An after-thought: Many audio exhibitors arrived at the Fair with much audio equipment and not a thing to play on it. Both tape and disc machines were shipped mute, so to speak, until some frantic staff member could dash over to Macy's and buy the first record that he could get hold of, or until some other exhibitor would kindly lend a tape. The business of audio is music. Bring along a good selection of records, chosen carefully, and have them in plain sight, where music lovers can see them and approve. It will do you no harm (and may bring you new followers) to display

a bit of Mozart and Bach and Beethoven. Even if it never gets played.

So here's to a musical Audio Fair III.

RECORDS

Varèse, Intégrales; Density 21.5; Ionization; Octandre.
Rene Le Roy, flute; N. Y. Wind Ensemble, Juilliard Percussion Orch., Waldman. **EMS LP EMS 401**

Gabrieli, Seven Canzonas for Brass Instruments.
N. Y. Brass Ensemble, S. Baron. **Esoteric LP ES 503**

Schutz, Weihnachts-Historie (The Christmas Story).
The Cantata Singers; Charlotte Bloecher, Wm. Hess, Paul Matthen, conducted by Arthur Mendel. **REB LP REB 3**

Ives, Symphony #3 (1901-04); Music of the Am. Revolution.
National Gallery Orchestra, Bales. **WCFM LP LP-1**

It was surely a milestone of some sort or other in American musical history when, 'tother week, no less than three copies (it sounded like more) of the Varèse recording listed above were used at the Audio Fair to demonstrate hi-fi audio equipment! Varèse, no less than Ives (of an earlier generation) has been one of the lost pioneers of ultra-modern music, than which nothing could be further removed from electronic engineering—or at least until now. Varèse is a Frenchman to the core, in spite of his long residence in the U. S., and an artist of the longest-haired sort you can imagine; but he was one of the first to discover that things like sirens and bottles and assorted bits of heavy machinery could be used to make music of a new sort. His music, in the 1920's, was violently, incredibly radical. Few ever heard it. Now, in the 50's, it sounds just as radical as ever—but it makes the most superb hi-fi material for wide range recording. And so Edgar Varèse comes into his own! The Varèse record consists of one work for massed percussion (including sirens), another that surely holds all "records" for sheer potency of brassed dissonance, and several more works that fall between these. You will either howl with pain or giggle with amusement—but remember that Varèse is held in very great respect by musicians, that his noisy experiments led to much that is already a solid part of today's music and quite taken for granted by you yourself.

Points of interest above: Note the listing of four tiny companies (two record shops, a lone engineer and a cooperative radio station) which can between them stand up to the very best on LP from any of the large companies. Such is LP recording these amazing days. The smaller companies, dozens of them, are beating the biggies at their own game.

Ives as a lone wolf experimenter in the 1900 period, also contributed much that is now taken for granted in music. His 3rd symphony is a mild work, based on old fashioned hymn tunes, mostly scored for strings, and you will find it quite agreeable though in 1904 it was highly eccentric. Very nice, quiet string recording, with what seems to be flat high end. Good.

Schütz and Gabrieli, from the 17th century, were two earlier experimenters. The Gabrieli brass music makes a superb record, as done in the live studio at Reeves in New York. (Note that clean, simple brass har-

monics allow for very high levels with relatively little tracking trouble.) Gabrieli practically invented instrumental "orchestral" music right here, applying the earlier choral techniques to massed groups of brasses. Schütz, writing in the dreary days of the 30 Years' War in Germany, developed much of the mixed voice-and-instrument style that Bach and Handel later used. Engineer Robert Blake (REB) obviously has a fine ear for miking this difficult variety of music and his record is worth an engineering study quite aside from the music itself. Trumpets, recorders, organ, solo voices, orchestra, chorus et al. Blake also recorded the Varèse LP.

Bizet, Carmen Suite; Smetana, Die Moldau
Orch. of the Viennese Symph. Soc., Singer. **Remington LP RLP 149-10 (10")**

Schubert, Symphony #1; Mozart, Fantasia in F minor, K. 608.
Orch. of Viennese Symph. Soc.; Vienna Symphony, Fekete. **Remington LP RLP 199-2 (12")**

Here are two of the best from the first batch of the new bottom priced Remington LP's, sold through department stores. The new material and/or processing method gives a surface that hisses quietly, like fine British shellac—hardly objectionable. As to durability, I couldn't say. Also, there is little in the way of quality that will interest a hi-fi man, some of the recording being thin and (on a good outfit) considerably distorted. But the Carmen-Moldau recording, above, is really excellent—no complaint at all; and the Mozart is good, too, though the Schubert on the other side is of the distorted type.

Important point for music-lovers is that there are a number of quite unusual musical items already in the list, a development that was hardly to be expected; the Mozart Fantasia, originally for mechanical organ, is one—though the arrangement and playing are both poorish—and another is the superb voice of Elizabeth Wysor in a potpourri of operatic arias. Keep an eye on these.

Brahms, Symphony #4 in E minor.
Boston Symphony, Munch **RCA Victor LP LM 1086**

Rachmaninoff, Piano Concerto # 2.
Wm. Kapell; Robin Hood Dell Orch., Steinberg. **RCA Victor LP LM 1097**

Here are two standard works re-done under new RCA auspices and on LP, and the slight perplexity noted last month re RCA's LPs continues—even though both of these and plenty more like 'em are excellent recordings.

The new Boston under Munch is a lighter, more streamlined orchestra in the sound than recently under Kousevitsky. The Brahms is given a nicely tailored, rather French performance that suddenly turns positively furious in the coda to the third movement and in the last movement. Interesting. The Rachmaninoff meanders its involvedly Romantic way, about as it always does (to my somewhat jaundiced ear) and my best comment is technical, that the piano is nicely balanced, a bit dead sounding, the orchestra well adjusted in volume but too much in the background as to liveness perspective.

As to recording characteristics—doubt. The Boston recording is on the beam, i.e.

of the sort one now expects from that section of RCA: a clearly distant-mike technique that seemingly dulls the highs on first hearing (no sharp edge to the strings, etc.). Yet a perfectly legitimate musical sound from the concert hall viewpoint—probably more "natural" than the forced brilliance of the famous ffrr technique with its steely sharp tone qualities. The Robin Hood Dell is a Philadelphia offshoot, recorded in the Academy of Music, reportedly a very fine hall for music. This recording is deader, decidedly, than the Boston recording, the orchestra similarly distant-miked, by the sound. Strange—but this one will play very nicely with only slight roll-off. If it was not recorded "flatter" than others of the RCA line, then we have here one of those combinations of mike technique (softening of the highs via distance), actual acoustics and, most important, the composer's sonorities—Rachmaninoff's tend towards the dark and fusty. Try this one yourself and be convinced. Not a good recording, however you play it (compare, if you wish, with the first mvt. of the same music on the "Twilight Concert" disc reviewed below); the piano is tinny, hard, there is no real bass nor much in the highs of interest. (In any case, the more I listen the more am I convinced that mike technique greatly affects the apparent "curve" of a finished recording and so, in practice, the equalization that must be used for a balanced sound in the reproduction.)

"Twilight Concert."
The Columbia Symphony Orchestra, Bodzinski. **Columbia LP ML 4311**

Sir Thomas Beecham conducting the Royal Philharmonic and the Columbia Symphony Orchestras. **Columbia LP ML 2134**

Here are two useful and pleasant potpourris of assorted stuff (too much to list, but the titles are mostly very familiar) that most engineers will want to have around for general test and background purposes. The Twilight Concert, with eight numbers including the first movement of the Rachmaninoff Concerto above, is a model of excellent recording with fine acoustics, low distortion, smooth, deep perspective, excellent low bass as well as fine highs, sharp but not too sharp. Sir Thomas (who offers the least interesting music) gets similar sounds from the same Columbia Orchestra on his ten-inch disc, one side of which he made here; but the Royal Philharmonic sound is noticeably duller, less live, not as satisfactory, by any means. Who said we couldn't match the British? Incidentally—here's the same old story: your tendency will be to boost the highs a bit for the Royal, to compensate for duller acoustics; and yet (with tape) the chances are good that the actual recording curve is the same for both sides of this record.

* * * *

Obvious conclusion to this month's technical look-see at new recordings: Can't *somebody* get after the haughty big companies and badger them into at least nominal conformity to one LP curve or perhaps better, an *area of tolerance* in respect to recording curve? By which I mean an accepted set of outside limits, as to turnover, pre-emphasis, within which all companies agree to operate. The tolerance should be, of course, small ideally but it will have to be quite large practically. Still—even such wide tolerance as, say, between 400 and 600 cps turnover and between 8 and 12 db pre-emphasis at 10,000 would be immeasurably better than the constant doubts to which we are now subjected.

AES NEWS

[from page 23].

year term), Arris Geranis, chief engineer, WBCK, Battle Creek, Mich.

Larry Wells, chief engineer for the Allen Electric Company, has been appointed Program Chairman for the coming year. Section meetings are held the third Tuesday of each month with the exception of June, July, August, and December. Members of other sections who may be traveling through the area are invited to attend meetings of the Southern Michigan Section, and may obtain information about the time and meeting place from any of the officers.

Employment Register

EMPLOYMENT OPPORTUNITIES may be listed here at no charge to industry or to members of the Society. For insertion in this column, brief announcements should be in the hands of the Secretary, Audio Engineering Society, Box F, Oceanside, N. Y. before the first of the month preceding the date of issue. Replies to box numbers should be addressed to AUDIO ENGINEERING, 342 Madison Ave., New York 17, N. Y.

★ Positions Open ● Positions Wanted

★ **Very Confidential.** Three of the nationally known television manufacturing companies have come to us for:

1. Quality Control Engineer
2. Receiving Tube Engineer
3. Purchasing Director who has experienced buying all component parts for television manufacturing.

These positions will pay $10,000 up and require the highest grade ability. Send full details of your experience, age, salary requirements privately to

Thorndike Deland
1440 Broadway,
New York 19, N. Y.

We are retained by our clients and do not charge the individual. All negotiations handled confidentially.

★ **Motion Picture Technicians.** The Signal Corps Photographic Center is interested in receiving applications from experienced motion picture technicians for openings as: film editors, recordists, mixers, cameramen, laboratory technicians, scenic artists, scenario writers, directors, animators, animation photographers, studio carpenters, grips, property men, studio electricians, and film librarians. Salaries range from $3450 to $6400. Those interested should write to the Signal Corps Photographic Center, 35-11 35th Ave., Long Island City 1, N. Y.

CLASSIFIED

Rates: 10¢ per word per insertion for noncommercial advertisements; 25¢ per word for commercial advertisements. Rates are net, and no discounts will be allowed. Copy must be accompanied by remittance in full, and must reach the New York office by the first of the month preceding the date of issue.

Equipment

WE PURCHASED a Brush Wire Recorder ($800 with extras) to fulfill two-year contract with national detective bureau for secret recordings. Contract has expired. For three hours of amazing wire recording quality (50-8000) without wows or extraneous noises, this recorder is peerless. In pinches, we have recorded music from which masters were dubbed. Price $175.00. Reco-Art Co., 1305 Market Street, Philadelphia 7, Penna.

FOR SALE: Two UTC LS-50 transformers, one each LS-12X, HA-101X, LVM-1 (500-ohm line to v.c.). Entire lot, $25.00. Box CD-1, AUDIO ENGINEERING.

FOR SALE: Custom radio-phono assembly in one-piece solid walnut cabinet, with Hallicrafter AM-FM chassis, JAP-60 spkr, Webster 100-27 with GE dual pickup, 7 cu. ft. infinite baffle chamber, Kimsul lined. $410. New York area only. Box CD-2, AUDIO ENGINEERING.

PRESTO 90-A amplifier for portable or studio recording. 30-15,000 cps, three microphone inputs, Weston VU meter, equalization selector, line recording, public address. Excellent condition. $225.00. Reco-Art Company, 1305 Market Street, Philadelphia 7, Penna.

ELECTRONICS TECHNICIANS WANTED

The RCA Service Company, Inc., a Radio Corporation of America subsidiary, needs qualified electronics technicians for U. S. and overseas assignments. Candidates must be of good character and qualified in the installation or maintenance of RADAR or COMMUNICATIONS equipment or TELEVISION receivers. No age limits, but must have at least three years of practical experience.

RCA Service Company offers comprehensive Company-paid hospitalization, accident and life insurance programs; paid vacations and holidays; periodic review for salary increases; and opportunity to obtain permanent position in our national and international service organization, engaged in the installation and maintenance of AM, FM and TV transmitters, electronic inspection devices, electron microscopes, theatre and home television, r-f heating equipment, mobile and microwave communications systems, and similar electronic equipment.

Base pay, oversens bonus, payments for actual living and other expenses, and benefits mentioned above add up to $7,000 per year to start for overseas assignments, with periodic review of base salary thereafter. Openings also available at proportionately higher salaries for specially qualified technicians with supervisory ability.

Qualified technicians seeking an advantageous connection with a well-established company, having a broad-based, permanent peacetime and wartime service program, write to

Mr. G. H. Metz,
Personnel Manager,
RCA Service Company, Inc.,
Camden 2, New Jersey

★ **Electronic Sales Engineer.** To sell top quality line of broadcasting, recording and motion picture studio sound equipment and components in New York Metropolitan area. Must have five years experience in sales of this type of equipment. Salary, commission, and expenses. Box 1201.

★ **WANTED:** Signal Corps Center, Fort Monmouth, N. J. has openings in the following Civil Service positions:

Military Instructors—Microwave relay, radar, radio electronics, fixed station radio, central office techniques, teletype installation and maintenance, repeater and carrier, dial central office maintenance, theory of electricity. $3100–4600.

Electronic Engineers—Participate in design, development, modification, construction, and testing of electronic equipment—radio, radar, wire communications, instrumentation, sonar, etc. Responsibility deepnding upon experience and ability. $3100–6400.

Technical Writers—Write, edit, prepare technical publications, handbooks, circulars, instruction books, etc. Edit and revise scientific manuscripts on radio, radar, electronics, communications, and photography. Write instruction manuals on theory, operation, and maintenance of Signal Corps equipment; determine media and method of presentation of material; prepare charts, graphs, schematic diagrams etc. $3100–5400.

Applicants for any of these positions should write Chief, Civilian Personnel Branch, Signal Corps Center, Fort Monmouth, N. J., submitting a completed Standard Form 57, "Application for Federal Employment" (obtainable at any first or second class post office) for review before going to Fort Monmouth for a personal interview.

PROFESSIONAL DIRECTORY

NEW LITERATURE

● **Cinema Engineering Co,** 1510 W. Verdugo Ave., Burbank, Calif. is now issuing Catalog 14-R titled "Non-Inductive Wire-Wound Precision Resistors". The catalog describes a line of resistors ranging in accuracy from one per cent to 1/20 of one per cent, and in wattage capacities from one-quarter to 10 watts. Charts and illustrations are included.

● **Electronic Instrument Co.,** Inc., 276 Newport St., Brooklyn 12, N. Y. is now releasing its 1951 catalog of kits and complete instruments in the Eico line. Included are VTVM's, oscilloscopes, sweep generators, signal generators, tube testers, signal tracers, volt-ohm-milliammeters, battery eliminators, high-voltage probes, r.f. probes, and crystal probes. Catalog will be mailed free on request.

● **Newcomb Audio Products Co.,** 6824 Lexington Ave., Hollywood 38, Calif. has just published a complete new catalog featuring Newcomb portable sound equipment for schools, churches, clubs, etc. All items are illustrated and thoroughly described with detailed specifications. Catalog will be mailed free on request.

● **Tube Department, Radio Corporation of America,** Harrison, N. J. is now supplying to those with technical interest in receiving tubes a revised edition of the popular booklet "RCA Receiving Tubes for AM, FM and Television Broadcast". As an added convenience to users of the booklet, a section is included where types of tubes having similar characteristics and the same heater or filament voltage are bracketed. Copy may be obtained from RCA tube distributors, or by sending 10¢ to Commercial Engineering, RCA Tube Department, Harrison, N. J.

● **Radio Tube Division,** Sylvania Electric Products, Inc., 500 Fifth Ave., New York 18, N. Y. is now supplying through authorized Sylvania distributors a 128-page loose-leaf book titled "Servicing TV Receivers." Devoted to the servicing and maintenance of home TV equipment, the new book is wire-bound permitting it to lie flat when in use. Extensive illustration includes 53 screen patterns, 17 wave-form patterns, and seven schematic diagrams.

ERRATUM

SAVAGE TRANSFORMERS LTD., Devizes, Wilts., England, carried an advertisement in the October issue in which the transformer impedances were indicated in "μ" instead of in "Ω." This regrettable error occurred somewhere between advertising production and final pages, and should not be assumed to indicate that some new transformer characteristic was intended.

Audio Engineering—1950
SUBJECT INDEX

AUTHOR INDEX

ADVERTISING INDEX

POWER AND IMPEDANCE MEASUREMENTS

DAVEN

OUTPUT POWER METERS

of unexcelled accuracy and reliability

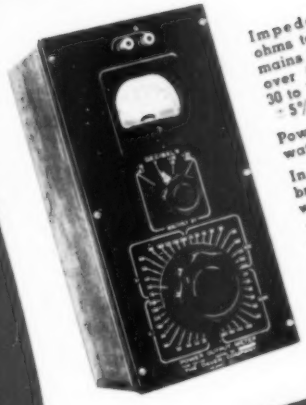
have many applications

The DAVEN Output Power Meters are designed to measure the actual power delivered by an audio signal system to a given load. However, because of the characteristics of the circuit, they are admirably suited to other applications, namely:

1. Determination of Characteristic Impedance of an A.C. Source.
2. Effects of Load Variation on a Signal System.
3. Transmission Line Equalization Measurements.
4. Measurement of Insertion Loss in Multi-channel Mixer and other complex circuits.
5. Filter and Transformer Measurements.
6. Radio Receiver Measurements.

The equipment shown on this page is built to DAVEN'S well-known standards of precision. Please write for more detailed data. Let our engineering department help you on specific problems.

TYPE OP-182



Impedance Range: 2.5 ohms to 20,000 ohms. Remains essentially resistive over frequency range of 30 to 10,000 cps. Accuracy ±5%.

Power Range: 0.1 mw. to 5 watts in steps of 0.1 mw.

Indicating Meter: Calibrated from 0 to 50 milliwatts and from 0 to 17 db. —Zero level: 1mw.

Meter Multiplier: Will change reading of indicating meter by ratios of 0.1:1, 1:1, 10:1, 100:1, or decibel reading by —10, 0, +10, +20.

TYPE OP-962

Characteristics similar to OP-961, except that it can measure up to 100 watts.

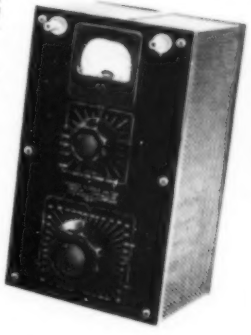
Impedance Range: 40 selected impedances between 2.5 and 20,000 ohms. Accuracy ±2% over frequency range 30 to 10,000 cycles.

Power Range: 0.1 mw to 100 watts in 0.1 mw steps. Range may be extended below 0.1 mw by use of external amplifier.

Indicating Meter: Calibrated from .01 watt to 1 watt and from —10 to +10 db. Zero level: 1mw.

Meter Multiplier: Extends range of meter from 0.01 to 100 times scale reading.

TYPE OP-961



Impedance Range: 2.5 ohms to 20,000 ohms. Remains essentially resistive over frequency range of 30 to 10,000 cps. Accuracy ±2%.

Power Range: 0.1 milliwatts to 50 watts in steps of 0.1 milliwatts.

Indicating Meter: Calibrated from 1 to 50 milliwatts and 0 to 17 decibels. Zero level: 1mw.

Meter Multiplier: Extends the power reading of the indicating meter from 0.1x to 1,000x scale value, or the db. reading from —10 to +30 db. in steps of 2 db.

THE DAVEN CO.

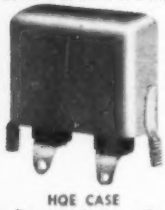
185 CENTRAL AVENUE • NEWARK 4, NEW JERSEY

PERMALLOY DUST TOROIDS FOR MAXIMUM STABILITY...

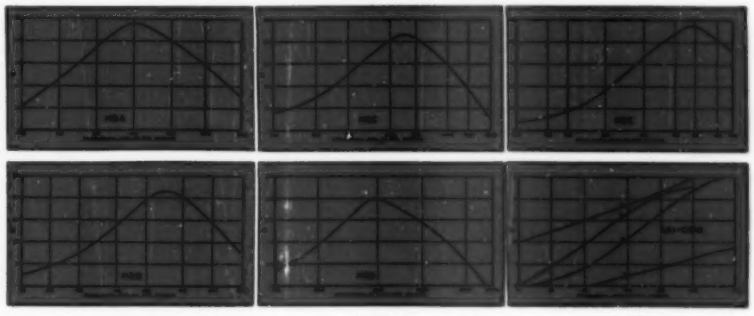
The UTC type HQ permalloy dust toroids are ideal for all audio, carrier and supersonic applications. HQA coils have Q over 100 at 5,000 cycles... HQB coils, Q over 200 at 4,000 cycles... HQC coils, Q over 200 at 30 KC... HQD coils, Q over 200 at 60 KC... HQE (miniature) coils, Q over 120 at 10 KC. The toroid dust core provides very low hum pickup... excellent stability with voltage change... negligible inductance change with temperature, etc. Precision adjusted to 1% tolerance. Hermetically sealed.

HQA, HQC, HQD CASE
1 13/16"Dia. x 1 3/16"High

HQB CASE
1 5/8"x 2 5/8"x 2 1/2"High



HQE CASE
1/2"x 1 5/16"x 1 3/16"High



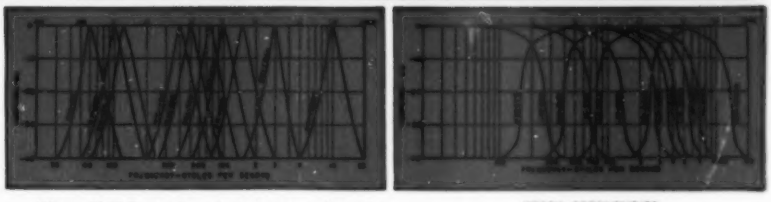
Type No.	Inductance Value	Net Price
HQA-1	5 mhy.	$7.00
HQA-2	12.5 mhy.	7.00
HQA-3	20 mhy.	7.50
HQA-4	30 mhy.	7.50
HQA-5	50 mhy.	8.00
HQA-6	80 mhy.	8.00
HQA-7	125 mhy.	9.00
HQA-8	200 mhy.	9.00
HQA-9	300 mhy.	10.00
HQA-10	.5 hy.	10.00
HQA-11	.75 hy.	10.00
HQA-12	1.25 hy.	11.00
HQA-13	2. hy.	11.00
HQA-14	3. hy.	13.00
HQA-15	5. hy.	14.00

Type No.	Inductance Value	Net Price
HQA-16	7.5 hy.	$15.00
HQA-17	10. hy.	16.00
HQA-18	15. hy.	17.00
HQB-1	10 mhy.	16.00
HQB-2	30 mhy.	16.00
HQB-3	70 mhy.	16.00
HQB-4	120 mhy.	17.00
HQB-5	.5 hy.	17.00
HQB-6	1. hy.	18.00
HQB-7	2. hy.	19.00
HQB-8	3.5 hy.	20.00
HQB-9	7.5 hy.	21.00
HQB-10	12. hy.	22.00
HQB-11	18. hy.	23.00
HQB-12	25. hy.	24.00

Type No.	Inductance Value	Net Price
HQC-1	1 mhy.	$13.00
HQC-2	2.5 mhy.	13.00
HQC-3	5 mhy.	13.00
HQC-4	10 mhy.	13.00
HQC-5	20 mhy.	13.00
HQD-1	.4 mhy.	15.00
HQD-2	1 mhy.	15.00
HQD-3	2.5 mhy.	15.00
HQD-4	5 mhy.	15.00
HQD-5	15 mhy.	15.00
HQE-1	5 mhy.	6.00
HQE-2	10 mhy.	6.00
HQE-3	50 mhy.	7.00
HQE-4	100 mhy.	7.50
HQE-5	200 mhy.	8.00

UTC INTERSTAGE AND LINE FILTERS

FILTER CASE M
1 3/16"x 1 11/16"
1 5/8"- 2 1/2"High



These U.T.C. stock units take care of most common filter applications. The interstage filters, BMI (band pass), HMI (high pass), and LMI (low pass), have a nominal impedance at 10,000 ohms. The line filters, BML (band pass), HML (high pass), and LML (low pass), are intended for use in 500/600 ohm circuits. All units are shielded for low pickup (150 mv/gauss) and are hermetically sealed.

STOCK FREQUENCIES
(Number after letters is frequency)
Net Price $25.00

BMI-60	BMI-1500	LMI-200	BML-400
BMI-100	BMI-3000	LMI-500	BML-1000
BMI-120	BMI-10000	LMI-1000	HML-200
BMI-400	HMI-200	LMI-2000	HML-500
BMI-500	HMI-500	LMI-3000	LML-1000
BMI-750	HMI-1000	LMI-5000	LML-2500
BMI-1000	HMI-3000	LMI-10000	LML-4000
			LML-12000

United Transformer Co.
150 VARICK STREET NEW YORK 13, N. Y.
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: ARLAB